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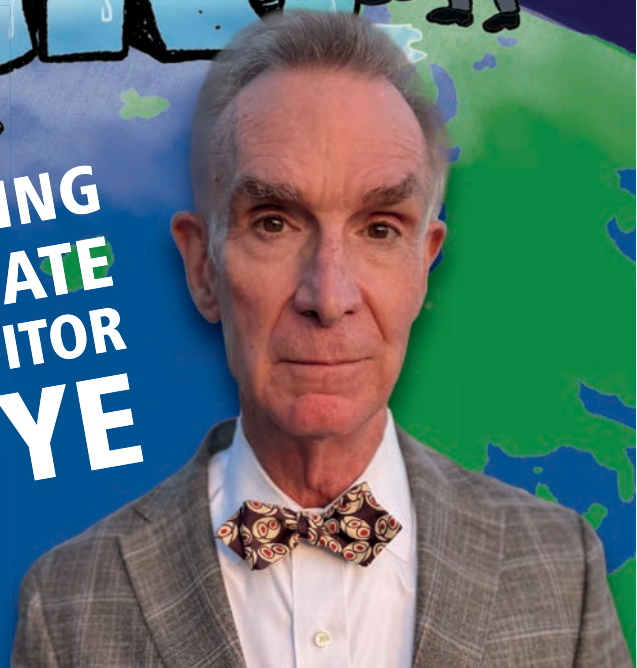
8 BONUS PAGES!

CLEAR THINKING ABOUT CLIMATE WITH GUEST EDITOR BILL NYE



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Skeptical Inquirer January/February 2025 | Volume 49 No. 1

SPECIAL SECTION ON CLIMATE WITH BILL NYE

7
Clear Thinking about Climate
BILL NYE

9
Misconceptions about Climate Change: An Educator's Guide
BERTHA VAZQUEZ

13
The Cranky Uncle Game: A Way to Logic-Check Misinformation about Climate Change
JOHN COOK

20
A Triple Threat to Humanity: Climate Change, Pandemics, and Anti-Science
MICHAEL E. MANN AND PETER J. HOTEZ

22
How Conservative Estimates of Climate Change May Destroy or Save the World
ERIC J. WARD

24
Sea Level Rise Science and Communication Are Hard but Keep Improving
JOHN R. MASHEY

25
Unmasking the Claims of the Antinuclear Movement: Climate, Health, and Energy at the Crossroads
AMARDEO SARMA

31
A Break in the Weather for American Middle School Climate Education
GLENN BRANCH

33
Hearts and Minds: Rebuilding Respect for Science through Engaging Science Communication
LAURA LINDENFELD

COLUMNS

FROM THE EDITOR
Bill Nye, the Climate Guy, Guest Edits a Special Section in Our 250th Issue 4

NEWS AND COMMENT
President-Elect Trump's Cabinet Nominations / Collapse of the Collapse Theory / News Bites 5

INVESTIGATIVE FILES
Investigative Strategies: Creative Advance Planning That May Solve Unusual Cases
JOE NICKELL 39

NOTES ON A STRANGE WORLD
Conspiracy Theories: A Call to Adventure
MASSIMO POLIDORO 42

THE PHILOSOPHER'S CORNER
It's All Bullshit: The Common Ground between Pseudoscience and Pseudophilosophy
MASSIMO PIGLIUCCI 44

BEHAVIOR & BELIEF
Spiritualist History in London (and Cambridge): A Skeptic's Tour
STUART VYSE 46

THE PRACTICAL SKEPTIC
Quick Guide to Modern Video Analysis Techniques for UAP (and UFOs)
MICK WEST 50

THE TIME WARP
To Hell with Near Death Experiences
CRAIG A. FOSTER 53

SKEPTICAL INQUIREE
Psi on the Blink: Street Light Interference
BENJAMIN RADFORD 55

FUN & GAMES 68

HOT TAKES 71

NYE & NOTABLE BOOKS 72

SECRETS REVEALED 72

LETTERS 73

OTHER FEATURES

57
Fringe Zoology: The (In)Convenience of Disappearing Evidence
FLOE FOXON

62
The Wim Hof Method: Ice Baths, Risky Breathing, and the Goop Lab
MARTIN BIER

FORUMS

35
From Believing the Conspiracies to Debunking the Funk
DAN WILSON

36
Beyond Belief: Raising a Skeptical Kid (in the Misinformation Age)
RONALD CROUCH

COMMENTARIES

65
The Genetic Book of the Dead Masterfully Illustrates Science Is Brimming with Wonder and Curiosity
BERTHA VAZQUEZ

66
A Lesson in Phoney Credentials
KAT MCLEOD

REVIEWS

Inherently Human: New Approach to Magic and Witchcraft
AUTUMN SWORD 69
Rethinking the Anthropology of Magic and Witchcraft
By Phillips Stevens Jr.

Mental Health and Wellness: Clarifying Fuzzy Boundaries
CASSANDRA L. BONESS 70
Mind the Science: Saving Your Mental Health from the Wellness Industry
By Jonathan N. Stea

7

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[FROM THE EDITOR

Bill Nye, the Climate Guy, Guest Edits a Special Section in Our 250th Issue

When my son Henry was in fifth grade, he had one of the most dynamic teachers either of us has ever known. Mr. Canada led the class in a project to upgrade a Barbie Jeep (the kind that kids could actually drive in their backyards) so that it ran off of solar panels added to the roof. This wasn't just a day-long project or a week-long project; they worked on that Jeep all year long. Many days, Henry excitedly rushed home and told me about their progress.

The next year, in sixth grade, he had another dynamic teacher by the name of Bill Nye, a name that I'm only able to say in full because neither "Bill" nor "Nye" alone feels quite right. When Bill Nye speaks to groups of teachers, he quips, "As I understand it, I've been teaching a lot of your classes this year." And this was certainly the case, thankfully, for Henry's sixth grade science teacher.

Henry was so excited about "the Science Guy" that when I learned Bill Nye was going to be the keynote speaker at the 2013 CSICon in Tacoma, Washington, I brought that enthusiastic eleven-year-old along for the journey. The keynote speech, titled "Bill Nye: Changing the World with Science," is available for viewing on CFI's YouTube channel. During the keynote, we received a masterclass in science communication. I was even able to take a photo of Henry with Bill Nye (he happened to be wearing a leg brace due to his recent appearance on *Dancing with the Stars*). A decade later, I was the lucky one getting my photo with Bill Nye during the 2023 CSICon, and having just started my job as Skeptical Inquirer's newest editor, I took the opportunity to ask him if he'd like to be a guest editor.

With Bill Nye as the guest editor of our 250th issue, the yesses seemed to come faster when I reached out to potential contributors, even for the challenging topic that he chose: climate change. Our first article in the special section is from Bertha Vazquez, a retired teacher, CFI's education director, and the coauthor of a new book *What Teachers Want to Know about Teaching Climate Change*. We also have a contribution from Michael Mann and Peter Hotez based on *Science under Siege*, their new book that notably shares the title with a book by Kendrick Frazier (SI's editor for forty-five years). Leave all your assumptions behind as you read additional pieces by John Cook, Eric J. Ward, John R. Mashey, Amardeo Sarma, and Glenn Branch. We end the section by asking Laura Lindenfeld to summarize her *Skeptical Inquirer Presents* talk that more broadly describes effective science communication.

Thank you to everyone involved in this issue of SI, and thanks especially to Bill Nye, the SI guy, for helping promote critical thinking about the climate. Lastly, many thanks to all the inspirational teachers who helped my son Henry along his path toward starting his career as a mechanical engineer, just like a quirky TV host we've all come to know and love.

—Stephen Hupp

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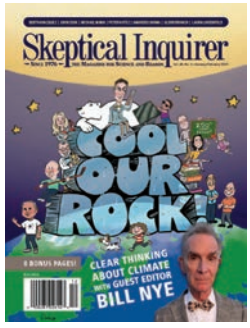

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President-Elect Trump's Cabinet Nominations: What Do They Mean for the Climate and Our Health?

Stephen Hupp

Guest Editor's note: Written in 1786, Article I, Section 8 of the U.S. Constitution contains the word science. *The president-elect has chosen a remarkable rogues gallery of people bent on ignoring the science of climate change and the fundamentals of public health. I encourage readers of this issue to remind people everywhere of the importance of science to our health, safety, and international competitiveness.*

This is the only article in this issue of Skeptical Inquirer that was written after the 2024 presidential election. Soon after the election, President-Elect Trump nominated Chris Wright, the CEO of an energy company, to be the Secretary of Energy. Like Trump, who has used the word *hoax* to refer to climate change, Wright opened a recent video on his on LinkedIn profile by saying, "There is no climate crisis." Trump also nominated Lee Zeldin, a former New York congressman, to lead the Environmental Protection Agency. When it comes to voting to protect the environment, Zeldin has a low lifetime score (14 percent) from the League of Conservation Voters (see scorecard.lcv.org).

In terms of health, Trump nominated Robert F. Kennedy Jr., a lawyer, to lead the Department of Health and Human Services. Kennedy has a history of spreading misinformation about health (see Stuart Vyse's SI article "From False Cause to False Cure"). Days later, Trump nominated Dr. Mehmet Oz, a cardiothoracic surgeon, to lead the Centers for Medicare and Medicaid Services. Dr. Oz also has a history of spreading health misinformation (see Dr. Harriet Hall's SI article "The Incorrigible Dr. Oz").

These nominations suggest that addressing climate change and supporting science-based medicine will not be a priority for the forthcoming Trump administration. The nominations still need to be approved by the U.S. Senate which will have a Republican majority in 2025.

Stephen Hupp is editor of Skeptical Inquirer.

The Collapse of the Collapse Theory

Nathan H. Lents

Often considered the last and most remote land mass to be inhabited by pre-agricultural human migration, Rapa Nui sits more than 2,000 miles from the coast of South America and 1,200 miles from the nearest island, Pitcairn. Not long after the Polynesians first arrived in double-hulled canoes between 800 and 1200 CE, they took to constructing the maoi, enormous stone monuments that have made the island world famous.

Shrouded in mystery, Rapa Nui has been the subject of several scientific disagreements, from the methods used to construct the monuments, each hewn from a single hunk of volcanic rock, to why the population dwindled to a few thousand by the arrival of Dutch explorers in 1722. A prominent theory holds that the natives committed ecocide, ravaging the local fauna and completely deforesting the island, all in service to their obsessive fabrication of more than 1,000 maoi.

Already on the ropes for lack of convincing evidence, the so-called "collapse theory" has now been dealt a fatal blow by DNA. Published in *Nature*, a large international team of researchers led by J. Victor Moreno-Mayer (and which included indigenous Rapanuian archaeologists), reconstructed the genomic history of Rapa Nui utilizing both modern genomes and ancient ones extracted from remains dating from the seventeenth through the twentieth centuries ("Ancient Rapanui Genomes Reveal Resilience and Pre-European Contact with the Americas," Moreno-Mayer et al., 2024). The researchers found no evidence for a seventeenth century population bottleneck, as predicted by the collapse theory. Instead, they found a stunning and stable degree of admixture with indigenous American populations, about 10 percent, that predates European contact by 300–500 years.

As further evidenced by detectable Native American admixture throughout Polynesia and the fact that Polynesians reached such far-flung islands as Tahiti and Hawai'i, the genetic data argues that, instead of ecocide and collapse, ancient Rapanuians simply engaged in migration and interbreeding, just as Europeans later did. And the deforestation that marooned them there is better explained by a transition to farming and settled life, as was occurring throughout Europe and Asia at the same time. ■

Nathan H. Lents is a CSI fellow and professor of biology at the City University of New York. He is author of the forthcoming book *The Sexual Evolution: How 500 Million Years of Sex, Gender, and Mating Shape Modern Relationships*.

News Bites: From Hurricane Fake Photos to Skeptical Inquirer's Audio Edition

Stephen Hupp

Deepfake Photos Spread after Hurricane Helene. On October 5, 2024, Lars Daniel, an expert on photo forensics, reported on deepfake photos generated by artificial intelligence (AI) in the aftermath of Hurricane Helene. The photos depicted a distressed youngster holding a wet puppy on a flooded street, and they quickly spread via social media. Daniel writes, "The rise of fake images tied to real disasters is not just a problem of misinformation. It is creating a deeper issue of emotional numbness and distrust." These photos had some clear signs of fakery, including an extra finger, but it won't be long before fake ones are indistinguishable from real ones. (For more, read "How Hurricane Helene Deepfakes Flooding Social Media Hurt Real People" at forbes.com.)

James Underdown Receives Lifetime Achievement Award. On October 6, 2024, CSI Fellow James Underdown received a Lifetime Achievement Award as part of California Freethought Day. Underdown is the executive director of the Center for Inquiry (CFI) West and founder of the CFI Investigations Group. In response to the award, Underdown quipped, "I was honored to receive this award from our colleagues to the north. They do great work up there, and I was humbled that they would recognize me—in both senses of the word!" (To learn more about California Freethought Day, visit freethoughtday.org.)

Conker Champion Faces Cheating Accusations. On October 13, 2024, Dave Jakins (age eighty-two) won the men's division of the World Conker Championship—it's kind of like the game "pencil break" but with chestnut seeds held by strings. Jakins's opponent in the men's final accused him of using a steel conker, and he was later found in possession of just such a device. Organizers are investigating by examining videos from spectators. (For more, read "Conkers Controversy" at apnews.com.)

Oh No! Ross and Carrie Say Farewell. On October 13, 2024, the podcast *Oh No, Ross and Carrie!* released a farewell message, announcing the end of the show (for the "foreseeable future," anyway). Over the course of thirteen years, cohosts Ross Blocher and Carrie Poppy released 420 episodes based on original investigations into "fringe science, spirituality, and the paranormal." Fortunately, the episodes will continue to be freely available through the Maximum Fun network. (For more, listen to the "Carrie and Ross Say Farewell" message of the podcast.)

Elon Musk Receives Rusty Razor Award. On October 19, 2024, as part of the QED (Question, Explore, Discover) conference in the United Kingdom, *The Skeptic Magazine* awarded Elon Musk the top prize for the "most prolific promotion of pseudoscience" due to his "enabling the widespread proliferation of misinformation, scams, inauthentic accounts and hate speech" on X (formerly Twitter). Conversely, archeologist Flint Dibble won the Ockham Award for Skeptical Activism for his work fact-checking claims about the lost city of Atlantis. (For more, read "Elon Musk Beats Dragon's Den Star Steven Bartlett to Rusty Razor Pseudoscience Award" at skeptic.org.uk.)

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Clear Thinking about Climate

BILL NYE

When Stephen Hupp and Barry Karr approached me about being a guest editor, I thought it would be easy enough, even recreational. I expected to sort through some fun pieces about various charlatans and rip-off artists. I looked forward to learning about a few tricks in the magic, mentalist, and psychic trades. And especially, I thought I might find another way to nudge credulous friends and acquaintances toward a more skeptical, well-reasoned view of the world writ large. But we agreed that perhaps we ought to focus on what this guest editor (that would be me) considers the two most serious problems facing us: climate change and critical thinking.

In every issue of Skeptical Inquirer, you'll find references to the astronomer Carl Sagan, and worthy references they are. After all, he repeatedly, articulately expressed concern about what nowadays we call the "disconnect" between what humankind has learned about nature and its natural laws and what most humans know about sci-

entific discoveries, the process of science, and countless provable scientific facts. As many of you may know, I took one class from Prof. Sagan thinking it would be fun—and it was. Along with having us write papers about formal critical thinking, Sagan often spoke of "comparative planetology," the runaway greenhouse effect, and the role of carbon dioxide in planetary atmospheres. This was back in the twentieth century (1977).

In that same 1977, James Black at Exxon (before it was Exxon-Mobile) predicted with remarkable prescience what would happen to our world if we were to continue burning fossil fuels at our prodigious rate. We have, and he was right. Later in 1988, James Hansen testified before the U.S. Congress about the threat of climate change. In the 1990s, I mentioned or described climate change in six separate episodes of my *Science Guy* shows, while Mike Mann published the hockey stick graph in 1995. And we've been going on about it ever since. A lot of good it's all done us.

Speaking (or typing) of changing the world: I hope you'll take particular notice of the piece about nuclear energy. It presents the classic engineering arguments for the increased use of nuclear power. But there's little mention of either NIMBY (Not In My Back Yard), or BANANA (Build Absolutely Nothing Anywhere Near Anybody [or Anything]). Are these sentiments irrational, or are they a product of the industry's safety record? The safety record is either excellent or mediocre depending on how the record is reckoned. Please have a look and give it some thought.

For me, the fundamental idea I believe we all need to embrace is this: Humankind is in charge now of our whole planet. This is not a gig we auditioned for. Our species has become so influential, so powerful, and frankly so dangerous, that we need to accept responsibility for managing our world. We control the fate of every species here, especially our own. And it's not that we need to somehow save Earth—Earth is going to be here no matter what humankind does. We want to preserve Earth's climates and ecosystems so that we, and virtually every other species here, can thrive. It really is up to us.

Overall, this issue is full of good information about disinformation. You'll find articles by the world's foremost thinkers on bad climate science and better science communication. There are also some ideas that I feel miss the mark. The latter are here, because maybe I'm wrong. This issue is written and published to help all of us skeptics—and perhaps everyone we've ever met—see the world the way we see it. And as I'm sure you know, that ain't so easy. Read on. ■

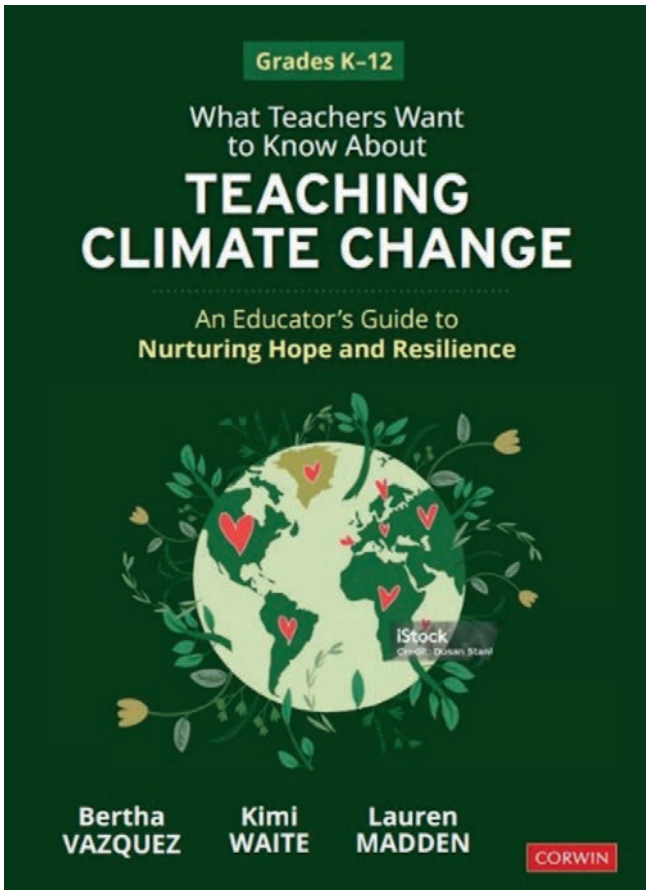
Carl Sagan testifying before Congress in 1985 on climate change. Source: YouTube.

Misconceptions about Climate Change: An Educator's Guide

BERTHA VAZQUEZ

My work with the Richard Dawkins Foundation for Reason & Science began with providing teachers engaging professional development and free lessons on evolution education. Teaching evolution introduces students to the exciting idea that we share a common ancestor with all life on earth. With this realization, students often change the way they view their fellow living things, encouraging a more environmentally minded perspective. And that's valuable because, for many teachers, including me, environmental education is not just a priority but a passion. Instilling a sense of wonder for the living world around us, along with a responsibility for the future of our planet, makes teaching science a very meaningful endeavor. I hold environmental education near and dear to my heart. So, when Debbie Hardin of Corwin Press reached out to me about writing a book about climate change for my fellow educators, I jumped at the chance. And of course, the topic of climate change has its share of misinformation.

One of the goals of the book I coauthored with Kimi Waite and Lauren Madden and published with Corwin Press—What Teachers Want to Know about Teaching Climate Change—*is to help teachers guide their students as they untangle the most common misconceptions about climate change. Using the critical thinking skills covered in the book, students can analyze evidence and sources like science sleuths, identifying credible information, and discarding misleading claims. Young people can become effective science communicators and an important part of the climate solution. Chapter 2 of our book addresses the ten most common climate misconceptions. Five of those misconceptions are summarized here.*



Misconception 1: The Fluctuations in Temperature Over the Last Hundred Years Can Be Attributed Solely to Natural Cycles

Students may argue that the climate of the Earth has always changed, so we shouldn't worry about climate change now. Scientists agree that natural phenomena have always contributed to the complex nature of the Earth's climate system. The Earth has undergone a series of ice ages and warming periods over geological time scales. Ice ages, or glacial periods, involve the expansion of ice sheets and glaciers, leading to cooler temperatures and lower sea levels. Interglacial periods follow, characterized by warmer temperatures and the retreat of ice. These cycles are influenced by factors like variations in the Earth's orbit, volcanic eruptions, and ocean currents. Variations in the Earth's orbit can affect the amount of solar radiation received, leading to long-term climate changes. Volcanic eruptions release particles and gases into the atmosphere, impacting sunlight penetration and temperature. And finally, ocean currents play a vital role in redistributing heat around the planet, influencing regional climate patterns.

But while it's true that the climate has changed naturally in the past, we need to understand that the changes happening now are mostly because of human activities like burning fossil fuels and cutting down trees. Think of a boat sailing along a river with a steady current, representing natural climate changes. You make slight adjustments to the sails to stay on course, symbolizing adaptations to past climate shifts. However, if a severe storm were to suddenly push the boat off course, representing anthropogenic (human-caused) climate

change, simply acknowledging the current and ignoring the storm wouldn't be enough to get back on track. To stay on course, we must actively address the ongoing and more significant climate changes caused by human actions.

To debunk this line of argument and several other misconceptions, we can teach our students the importance of what scientists call "multiple lines of evidence." When making a claim, having multiple, different lines of evidence supports scientific understanding and decision making. Complex issues like climate change require this approach. Relying on a single study, experiment, or observation can be problematic because it may be flawed, biased, or misinterpreted. Gathering evidence from different sources and methods and seeing that all the evidence converges builds confidence in the overall conclusion. It reduces the effects of bias, errors, and limitations of individual sources. It also helps identify any inconsistencies or contradictions in the data. A great way to explain this to our students is to compare it to the work of police detectives and district attorneys trying to solve a crime and prosecute the defendants. They may not be satisfied with just one eyewitness report. They know that the strongest cases have lots of evidence all pointing to the same person: DNA, fingerprints, bank records, video, witnesses, etc.

The multiple lines of evidence converging on the fact that climate change is caused by human activity include the following:

- The increase of greenhouse gas concentrations, the warming of the atmosphere and oceans, and other climate-related impacts all point to human-caused climate change.
- The rate of climate change is much faster now than it has been in the past. The average rate of increase in the combined land and ocean temperature has been 0.14 degrees Fahrenheit (0.08 degrees Celsius) per decade since 1880. Since 1981, the rate of increase has been more than twice as fast, at 0.32°F (0.18°C) per decade (National Centers for Environmental Information, 2022).
- Data from tree rings satellites, ice core studies, sediment layers, weather station records, observations of glacier retreat, and sea level rise all point to an abnormal temperature increase.

Natural cycles do not explain these changes. Scientists emphasize that when this consistency across diverse sources exists, it greatly strengthens the conclusion that recent climate change is primarily driven by human activities.

In addition, even though the Earth's climate has changed before, we need to remember that our modern way of life has developed during a time of otherwise stable climate. The Earth's climate has been relatively stable for the last 10,000 years (Schmidt & Hertzberg, 2011). The climate anomalies we are witnessing are not just random fluctuations but compelling evidence of a changing climate system. The increasing magnitude, frequency, and global consistency of these anomalies, along with their alignment with scientific predictions, strongly suggest that big changes now could cause problems for people and nature.

Misconception 2: Colder Winters in Some Areas Means That the Earth Isn't Warming

The late senator James Inhofe, a Republican from Oklahoma, brought a snowball to the floor of the U.S. Senate in February 2015 as a symbolic gesture to express doubt about climate change. Inhofe was a prominent climate change doubter who often questioned the scientific consensus on anthropogenic global warming. The snowball was meant to imply that because it was cold on that particular day, global warming couldn't be occurring.

Students have probably heard this misconception over and over, and it's an important one to help them understand. The misconception that colder winters in some areas mean that the Earth isn't warming stems from a misunderstanding of the difference between *weather* and *climate*. *Weather* refers to short-term atmospheric conditions, including temperature, precipitation, and wind patterns, that occur over a specific period and in a specific location. On the other hand, *climate* refers to long-term patterns and trends in weather over extended periods (decades to centuries) and across larger geographic scales.

Climate scientists study long-term trends in average global temperatures, not short-term variations in local weather. There will always be temperature fluctuations, with some areas experiencing colder-than-average conditions in a given year. However, these fluctuations do not negate the broader trend of global warming.

Many arguments that misrepresent climate change use what are known as *logical fallacies,* patterns of reasoning that contain flaws, either in their logical structure or in their premises (Trecek-King, 2024). *Cherry-picking* is one of the most common logical fallacies; this is when someone focuses only on evidence that supports their stance while ignoring all the evidence that contradicts it. Pointing out that a snowy day in April must mean climate change is not real is a classic example of cherry-picking.

Misconception 3: A Few Degrees Warmer Won't Make a Big Difference

This misconception assumes that climate change is linear when, in fact, it's nonlinear. What's the difference between a linear and nonlinear relationship? Imagine riding a bike on flat ground. If you push the pedals harder (input), you consistently go faster (output). The harder you push, the faster you go in a perfectly straight line on a graph (see Figure 1a). The relationship is linear. Now, imagine climbing a hill. Pushing the pedals harder (input) might make you go faster at first, but as the slope gets steeper, the effort you put in won't translate to the same increase in speed (output). Your progress would look like a curved line on a graph, not a straight line (Figure 1b). In this case the relationship is nonlinear.

Figure 1a shows how a few degrees can, indeed, make a difference. It depicts a linear relationship. Figure 1b depicts a nonlinear relationship. Climate is a nonlinear, complex system with many interacting parts. A small temperature rise can disrupt weather patterns, ocean currents, and ecosystems in

unpredictable and potentially devastating ways.

The misconception that a few degrees warmer won't make a big difference underestimates the significant and far-reaching impacts of even small increases in global temperatures. Why? Because climate change isn't just about temperatures rising a few degrees uniformly in a linear progression as shown in the graph. Warming, even seemingly small amounts,

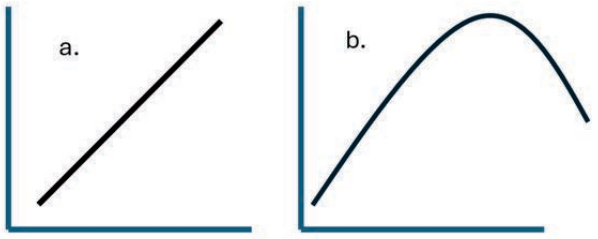


Figure 1: A linear relationship (left) and a nonlinear relationship (right)

disrupts complex environmental systems, leading to nonlinear changes.

The nonlinear effects of climate change include the following:

- Climate change disrupts complex environmental systems, leading to extreme and unpredictable weather events: heatwaves, droughts, floods, and storms.
- Rising sea levels threaten coastal communities and ecosystems.
- Ocean acidification harms marine life and disrupts food webs.
- Warmer water temperatures disrupt the delicate balance between corals and their symbiotic algae, leading to coral bleaching and, ultimately, death.
- Loss of biodiversity alters entire ecosystems. For example, keystone species are vital to their ecosystems. They are species that have a disproportionately large effect on their environment relative to their abundance. The polar bear is a prime example. As a top predator, it helps maintain balance in the Arctic. However, climate change is melting sea ice, disrupting the polar bear's habitat and food sources. This decline threatens not only polar bears but the entire Arctic ecosystem of which the polar bear is an integral part.
- Small temperature increases can push the Earth's climate system toward critical thresholds and tipping points, potentially causing abrupt and irreversible changes like melting ice caps.
- Ocean currents are disrupted. For example, as the cold fresh water from melting ice enters the ocean in the North Atlantic, it can affect the Gulf Stream, an important ocean current. If the Gulf Stream slows down, the warm air it carries over Europe will disappear and the temperatures in Europe will drop. The rainfall in South America will decrease, causing a potential disaster for agriculture (Turner, 2023).
- Additional greenhouse gases are released from thawing permafrost, which in turn causes an acceleration of warming.

Misconception 4: The Majority of Living Things Will Adapt to All Climate Change

Some plants and animals can adapt to climate change, but it's crucial to dispel the misconception that this means all will adapt successfully or that adaptation alone is enough to solve the problem (Iowa State University, 2019). The ability of species to adapt to changes in their environment is limited in several ways.

- Evolution takes *a lot of time*, and some populations of organisms simply don't have the necessary genetic variations to adapt quickly enough to survive changing environmental conditions. Mutations in a population do not happen because the species wants or needs them.
- Human activities such as deforestation and urbanization can restrict the movement of many species and limit their ability to find suitable new habitats with better conditions.
- In some cases, after habitat is destroyed there are *no* suitable new habitats.

Species rely on specific interactions with other species to survive, so if some species adapt differently or disappear due to climate change, it can disrupt entire ecosystems, leading to cascading negative effects. For example, the temperature is the primary factor affecting the timing of natural events such as tree leafing and insect emergence, whereas the length of the day triggers bird migration. Climate change results in earlier spring temperatures, but the day length remains constant. As a result, a mismatch may arise because birds may arrive ear-

lier than the optimal food availability, affecting ecosystems where species depend on synchronized timing for survival (Forschungsverbund Berlin, 2019).

The bottom line is that evolution can't run as fast as climate change is galloping. Help students understand that expecting animals will adapt to climate change is like expecting a marathon runner to keep up with a speeding car. Species evolved over millennia to survive in their environment, but these adaptations may not be sufficient to cope with the rapid pace of human-induced global warming.

Critics who claim that if animals adapted in the past they can adapt today are committing another logical fallacy, the fallacy of false equivalence. Comparing fast, anthropogenic climate change to the gradual, natural climate change of the past is comparing apples to oranges. In addition, let's not forget that 99.9% of species have gone extinct, sometimes as a result of the relatively slower, natural climate changes (Greshko & National Geographic Staff, 2019).

We can help by identifying and protecting areas where species display genetic variation, such as conserving marine and land-based ecosystems in their natural state. This includes intentionally enhancing connectivity between natural habitats and creating pathways for animal migration.

These measures would allow species to move to cooler regions, while also promoting the growth of larger, more interconnected populations that can foster genetic diversity. Dan Majka, a cartographer and analyst at the Nature Conservancy, has created a series of maps that illustrate the corridors that mammals, amphibians, and other animals will need to use as they move to new habitats under current models of projected climate change. Majka's interactive map enables both scientists and the general public to visualize the continent-wide impact of climate change on animals and the corridors they will require for movement.

Misconception 5: It Will Be Hundreds of Years Before Climate Change Affects Humanity

It's tempting to brush off climate change as a future problem, but unfortunately, the truth is far more urgent.

We're already experiencing the effects of climate change. From intensifying heatwaves and droughts (and resultant fires), to floods, to rising sea levels, and increased intensity in storms, climate change is leaving its mark across the globe. These aren't just distant statistics; these climate change events are disrupting lives, livelihoods, and entire ecosystems right now. In the next 5 to 10 years, we can expect a warmer atmosphere, a warmer and more acidic ocean, higher sea levels, and larger changes in precipitation patterns (World Meteorological Organization, 2024).

Think of the proverbial ostrich with its head in the sand. Ignoring the issue won't make it disappear. In fact, delaying action now will only intensify the problem later. The longer we wait, the harder and costlier it becomes to adapt and mitigate the effects. We risk crossing irreversible tipping points and jeopardizing the future for generations to come.

And unfortunately, vulnerability to climate change isn't distributed equally. Low-income communities and countries often lack the resources to cope with these changes, bearing the brunt of the consequences while contributing the least to the problem. It's a matter of social justice as much as environmental responsibility (IPCC, 2022).

This excerpt was taken from Part I of What Teachers Want to Know about Teaching Climate Change *published with Corwin Press. Part I lays the foundation for teaching climate change, discussing the history of climate science, misconceptions, and equity. Part II emphasizes data literacy and how our identities and biases can often affect our acceptance of the science more than the facts can. Part III focuses on fostering hope in students and channeling climate anxiety into activism. Finally, Part IV looks at fitting climate change into existing educational frameworks and advocating for climate change in schools and districts. Throughout the book, there are educator-submitted success stories, vignettes, and resources, along with tips for making a difference. The book ends with a wealth of classroom resources in the appendix and links to a free curriculum on the companion website.*

What Teachers Want to Know about Teaching Climate Change *is available now for preorder at: https://us.corwin.com/books/teaching-climate-change-289495. The expected publication date is February 25, 2025.* ■

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The Cranky Uncle Game: A Way to Logic-Check Misinformation about Climate Change

JOHN COOK

When we think of the damage caused by misinformation, we tend to think of false beliefs. Misinformation reduces acceptance of the reality of climate change, raises doubts about the safety of vaccines, and inspires false beliefs such as flat-earthism. But the damage caused by misinformation goes beyond beliefs, affecting people's behavior in ways that harm society. For example, hearing a conspiracy theory about climate change makes people less likely to engage in politics (Jolley and Douglas 2014).

Given the damage misinformation can and is doing, it's imperative that we push back. The most common tool we have for countering misinformation is fact-checking. Explaining the facts is certainly valuable, and an analysis of many studies measuring the impact of fact-checking found that they tend to have a positive effect on political beliefs (Walter et al. 2020). However, there are limitations to what fact-checking can address.

One form of misinformation that is difficult to fact-check is *paltering*: the use of true statements to convey a misleading impression (Schauer and Zeckhauser 2009). A form of paltering often found in climate misinformation is the technique of *cherry picking*, which involves carefully selecting data that leads to a conclusion different from what you'd get if you considered all the available evidence (Cook 2020). For example, one might highlight a single growing glacier to argue that global warming isn't melting glaciers when globally most glaciers are shrinking. Another example of cherry picking is narrowing your focus to a short time period to make claims about long-term trends. A stark example of this is Bjorn Lomborg citing two years of sea level data when there was a temporary pause in sea level rise to argue that the problem was not as bad as scientists had been reporting (see Figure 1).

Greenwashing is another example of using factual statements to paint the false impression of an organization (or sometimes government) behaving in environmentally friendly ways. For example, a company will boast about how they've spent millions of dollars on renewable energy projects while failing to disclose that this outlay composes a tiny fraction of their overall budget, which is overwhelmingly spent on fossil fuels. This leaves people with the impression that the company is behaving responsibly, and the tactic works: greenwashing has been found to increase positive attitudes toward fossil-fuel companies (Friedman and Campbell 2023).

90
0
Sea level rise (mm)
"Over the past two years, sea levels have not increased at all. Actually, they show a slight drop. Should we not be told that this is much better than expected?"
Bjorn Lomborg
SEA LEVEL RISE
1993
Year
2018

Figure 1: Cherry picking sea level rise by Bjorn Lomborg.

Another challenge for fact-checkers are *hidden*

premises or *unstated assumptions* in misleading arguments. An example of this is when someone argues that "the climate has always been changing" and so climate change is nothing new. Statements such as this may sound superficially persuasive to some because they implicitly argue that the current climate change is not human-caused while relying on unstated assumptions. This kind of argument is difficult to fact-check, because the misleading part isn't explicitly stated, allowing the person spreading misinformation to cover their tracks and avoid accountability (Birks 2019).

Because of these limitations of fact-checking, we need to make more use of a complementary method of identifying misleading arguments: logic-checking. By this, I mean identifying the presence of logical fallacies and misleading rhetorical techniques. Logic-checking can address many of the types of misinformation that fact-checking is ill-equipped to deal with. In addition, there's another benefit to logic-checking. Not only does it help spot misleading content, but it also informs one of the most effective interventions for countering misinformation: logic-based inoculation.

In this article, I will outline how to logic-check claims using critical thinking. I will then delve into the research studying the powerful benefits of logic-based inoculation. I'll finish by presenting a real-world example of this approach in action and a practical way you can counter misinformation with facts and logic.

Using Logic-Checking to Identify Misleading Content

Logic-checking involves identifying whether an argument possesses logical fallacies or misleading rhetorical techniques. But how do you logic-check? Critical thinking philosophers Peter Ellerton and David Kinkead and I developed a step-by-step methodology for deconstructing and analyzing misinformation (Cook et al. 2018). Figure 2 shows a simplified version of our flowchart (see http://sks.to/cafe for a three-minute video explainer at the Critical Thinking Cafe).

Let's apply this approach to the earlier "the climate has always been changing" example. The first step is to deconstruct the original claim into an argument structure, consisting of premises (starting assumptions) and a conclusion. At this point, it's important that the deconstructed argument is a faithful rendition of the original claim. You don't want to construct a straw man that is a weakened version of the original claim, making it easier to debunk. Instead, you want to build a "steel man" version of the original claim—as strong an argument as possible. In our example, the premises are "climate has always changed" and "climate is changing now." The conclusion, implicit in this case, is "current climate change is naturally caused."

The second step is to check for logical validity. A logically valid argument is one where if you assume (for the sake of argument) that the premises are true, then it logically follows that the conclusion must also be true. If the conclusion does not logically follow from the premise, then the argument is logically invalid. In our deconstructed example, the argument is logically invalid. While it is true that climate has changed naturally in the past, it doesn't necessarily follow that the climate must be natural now. There might be other causes of current climate change, so in this case, the conclusion does not logically follow from those two premises.

If the argument is logically invalid, the next step is to add to the deconstructed argument any hidden premises that make the argument logically valid. The purpose is to add one or more premises such that if you assume all your premises are true, then logically, the conclusion must be true also. In our example, the

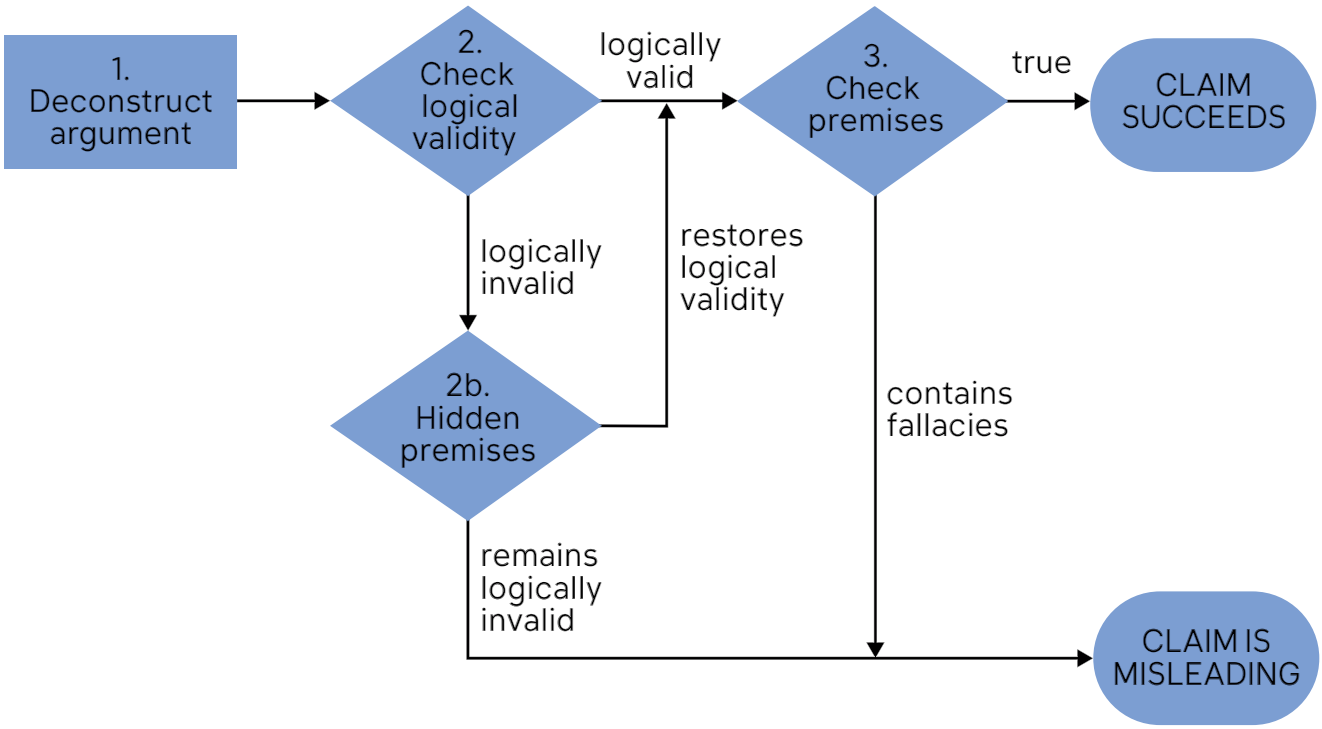

Figure 2: Flowchart for deconstructing claims (Cook et al. 2018).

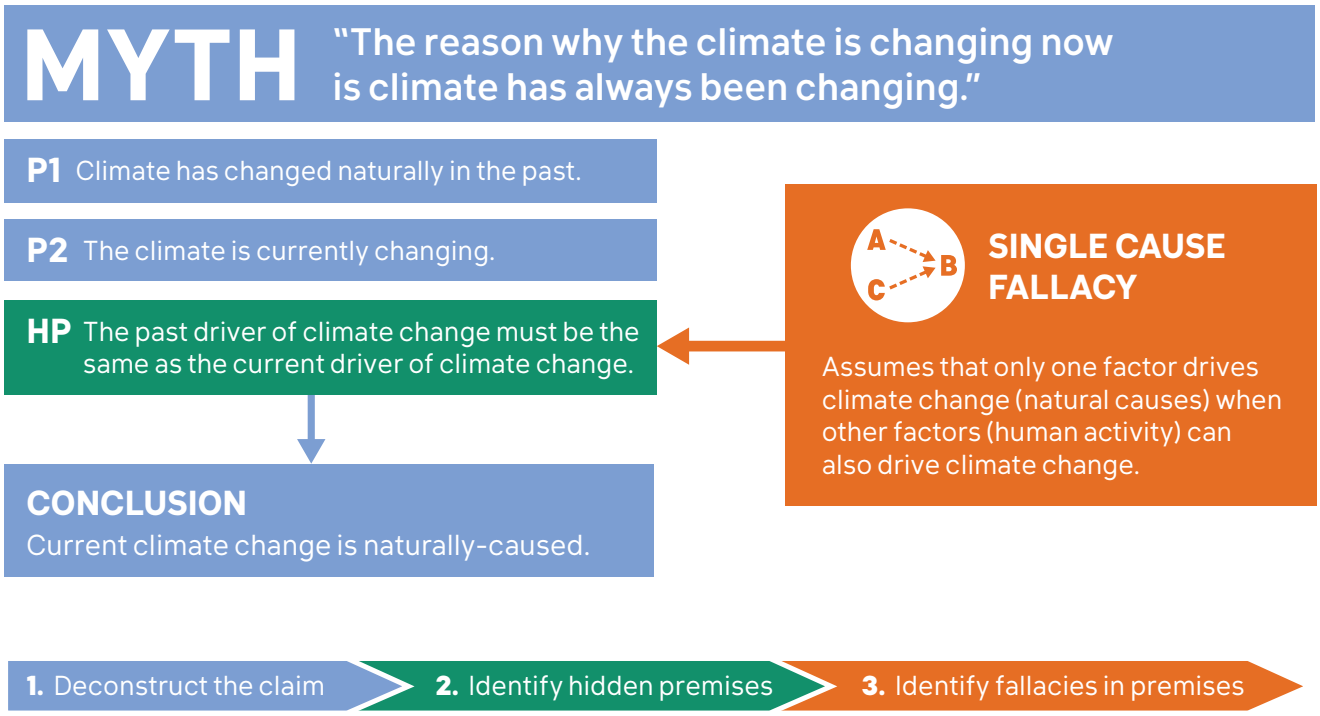
MYTH
"The reason why the climate is changing now is climate has always been changing."
P1 Climate has changed naturally in the past.
P2 The climate is currently changing.
HP The past driver of climate change must be the same as the current driver of climate change.
CONCLUSION
Current climate change is naturally-caused.
A
B
C
SINGLE CAUSE FALLACY
Assumes that only one factor drives climate change (natural causes) when other factors (human activity) can also drive climate change.
1. Deconstruct the claim
2. Identify hidden premises
3. Identify fallacies in premises

Figure 3: Deconstructing the "past climate change" argument.

hidden premise that makes the argument logically valid is the assumption that whatever caused climate change in the past must be the same as what's causing climate change now.

Once the argument has been made logically valid, the third and final step involves examining each premise for logical fallacies. In our example, the first two premises are true. Climate *has* changed naturally throughout Earth's history. The climate *is* currently changing. However, the third, newly added hidden premise is where the argument commits its logical fallacy. The assumption that what's driving climate change now must be the same as the past driver commits *single cause fallacy*, assuming that only one factor drives climate change. This assumption is fallacious when there are potentially multiple causes, as is the case in climate change when you have both anthropogenic factors and natural factors driving it. Figure 3 visualizes the three steps involved in deconstructing and analyzing the "past climate change" argument.

This example illustrates the potential of critical thinking deconstruction. First, it addresses implicit misinformation by making the argument explicit. Second, it identifies hidden premises not articulated in the original claim. Third, by breaking up a claim into its individual premises, it allows you to surgically identify where and how an argument misleads.

The importance of hidden premises was driven home in recent research where I collaborated with an interdisciplinary team to deconstruct a wide range of climate myths (Flack et al. 2024). Our goal in this research was taking another step toward the holy grail of fact-checking: automatic detection and debunking of misinformation. We had already trained a machine learning model to detect climate misinformation (Coan et al. 2021). To detect climate myths, first we must develop a comprehensive taxonomy of the different claims made by climate contrarians (Figure 4). However, our model didn't know whether the claims were true or false. We simply trained it to detect the claims in our taxonomy without making judgments about their veracity.

To determine whether the claims in our taxonomy were misleading, we went through every claim in the taxonomy, deconstructing it using the critical methodology from Cook et al. 2018. We found that every claim in the taxonomy contained misleading fallacies. In fact, most claims committed more than one fallacy. Most important for the current discussion, we found that 91 percent of the claims contained hidden premises with logical fallacies. In other words, the overwhelming majority of climate misinformation contains misleading hidden premises. This underscores the importance of logic-checking to identify potentially misleading arguments.

As a communication researcher, my original motive for developing a critical thinking approach to deconstructing misinformation was needing a reliable way to identify logical fallacies. This was because of my psychological research into countering misinformation.

Logic-based Corrections

It was during my PhD that I first stumbled upon the potential of using logic to counter misinformation. I designed an experiment where participants were warned with a message designed to "prime" them to be more resilient against misinformation (Cook et al. 2017). The research was based on inoculation theory, a branch of psychological research that borrows the idea of vaccination and applies it to knowledge (McGuire and Papageorgis 1961). Just as exposing people to a weakened version of a virus can convey immunity when they encounter the real virus, in a similar way, exposing people to a weakened version of misinformation can convey cognitive immunity so that they're less likely to be misled by real misinformation.

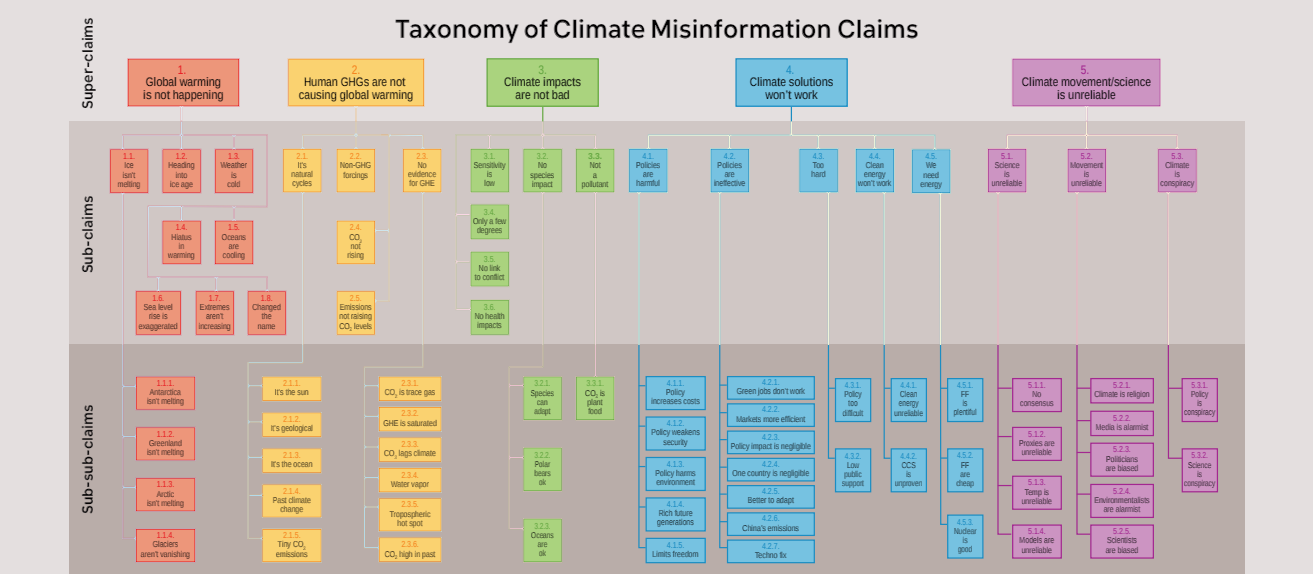
Taxonomy of Climate Misinformation Claims
Super-claims
Sub-claims
Sub-sub-claims
1. Global warming is not happening
2. Human GHGs are not causing global warming
3. Climate impacts are not bad
4. Climate solutions won't work
5. Climate movement/science is unreliable

Figure 4: Contrarian claims about climate change (Coan et al. 2021).

The misinformation used in the experiment was the Global Warming Petition Project, a website casting doubt on the scientific consensus regarding human-caused global warming. The problem was I had previously run experiments testing the powerful effect of communicating the 97 percent scientific consensus on climate change (Cook and Lewandowsky 2016). My goal as an experimenter was to warn people against misinformation casting doubt on the scientific consensus without mentioning the 97 percent consensus so I could measure the effectiveness of the warning. I achieved this by generally warning people against the misleading technique used in the Petition Project: fake experts. These are people who convey the impression of expertise but don't have the relevant expertise. The Petition Project featured 31,000 science graduates but only a small percentage had relevant climate expertise (Anderson 2011). In my warning, an example of the fake expert technique used in tobacco misinformation was provided to make the message more concrete. One randomly selected group of participants was warned about the fake expert strategy, then shown misinformation from the Petition Project. Another random group was shown just the misinformation.

The results from this experiment yielded several insights. First, when people were shown misinformation without a warning, the misinformation reduced people's climate perceptions. Climate misinformation has a negative effect, but it doesn't work the same for everyone—some people are more persuaded by misinformation. Climate misinformation is polarizing, causing people to move further away from each other in their climate beliefs. Second, for the group who were shown the warning before the misinformation, the misinformation was completely neutralized across the political spectrum. This tells us that whether people are conservative or liberal, no one likes being misled. Aversion to being deceived is bipartisan.

Finally, these results tell us that by explaining the misleading techniques used in misinformation, you can counter misinformation across topics. The Global Warming Petition Project was neutralized without being mentioned. You can tackle polarizing issues such as climate change by sidestepping cultural triggers and instead explaining general misleading techniques.

In a follow-up study, we pitted facts against logic to see which was more effective in fighting misinformation (Vraga et al. 2020). The climate myth used in the experiment was "CO_2 is plant food so we should emit more CO_2." The fact-based approach explained that plants need a range of factors to flourish, including a regular water supply and comfortable temperature range, both of which are disrupted by climate change. The logic-based approach explained that the plant food myth committed the fallacy of oversimplification by focusing on just one factor required for plant growth. I also tested whether it mattered if the corrections came before (*prebunking*) or after (*debunking*) the misinformation. Figure 5 shows both corrections, which also used cartoons as we were at that time experimenting with using humor in response to misinformation.

We found that the fact-based approach only worked if it came *after* the misinformation. If people saw the facts first, then the myth was the last thing they saw; the myth canceled out the facts. This is consistent with other studies finding that misinformation can cancel out factual explanations (McCright et al. 2016; van der Linden et al. 2017). However, the logic-based approach was effective in countering the misinformation whether it came before or after. In either situation, the logic-based correction reduced belief in the plant food myth, showing it to be more robust than factual explanations.

Logic-based corrections work. They neutralize polarizing misinformation. They work across the political spectrum. They work regardless of the order in which people receive them. And they work across topics. We can create general logic-based inoculations targeting misleading techniques that are effective against multiple myths. This is particularly useful because we don't know what exact form misinformation will take in the future. We don't have to constantly play whack-a-mole against specific myths if we can inoculate people against general techniques.

However, the challenge with the logic-based approach is that

there are a lot of logical fallacies and rhetorical techniques to be found in misinformation. People who spread misinformation draw on a vast array of techniques to mislead us. How are we to remember the long list of misleading techniques? I've found the acronym FLICC is helpful, listing five main techniques of science denial: fake experts, logical fallacies, impossible expectations, cherry picking, and conspiracy theories. However, the FLICC five aren't just individual techniques but categories summarizing a host of different techniques, fallacies, and traits of conspiratorial thinking. Over time, I have developed FLICC into a more comprehensive taxonomy of misinformation techniques (Cook 2020). A quick scan of the FLICC taxonomy in Figure 6 shows

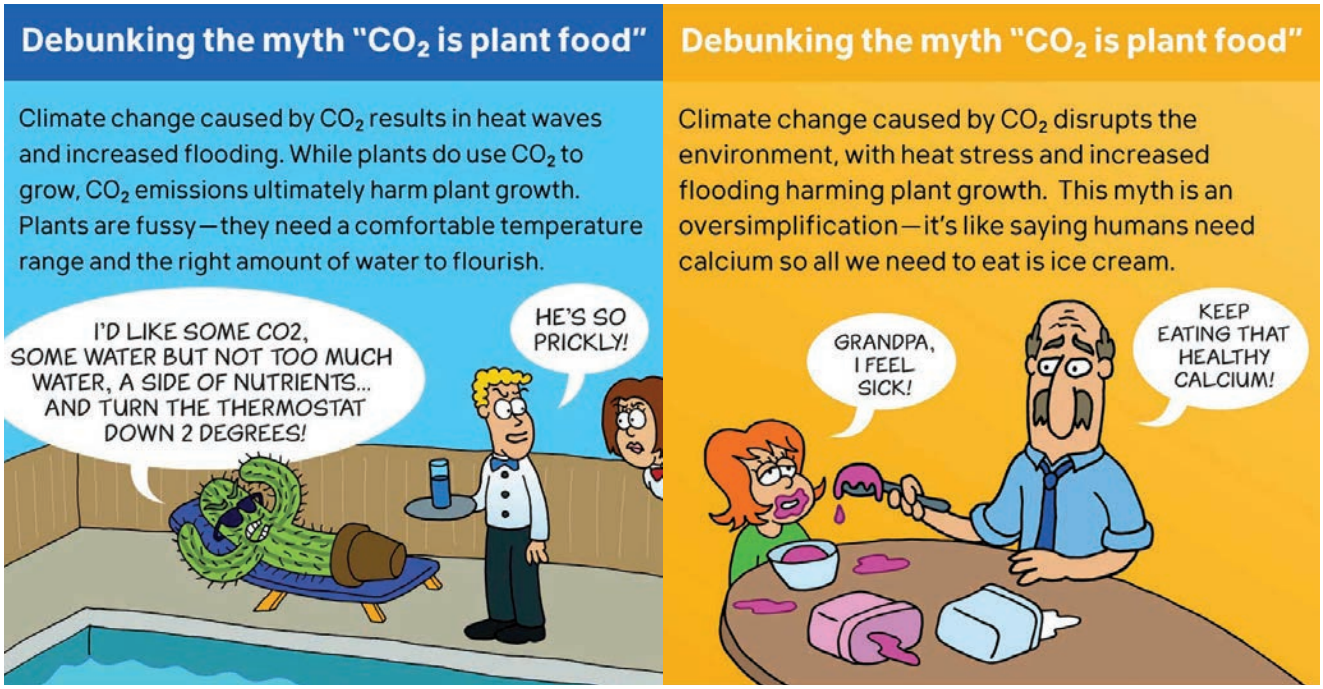
Debunking the myth "CO_2 is plant food"
Climate change caused by CO_2 results in heat waves and increased flooding. While plants do use CO_2 to grow, CO_2 emissions ultimately harm plant growth. Plants are fussy—they need a comfortable temperature range and the right amount of water to flourish.
I'D LIKE SOME CO2, SOME WATER BUT NOT TOO MUCH WATER, A SIDE OF NUTRIENTS... AND TURN THE THERMOSTAT DOWN 2 DEGREES!
HE'S SO PRICKLY!
Debunking the myth "CO_2 is plant food"
Climate change caused by CO_2 disrupts the environment, with heat stress and increased flooding harming plant growth. This myth is an oversimplification—it's like saying humans need calcium so all we need to eat is ice cream.
GRANDPA, I FEEL SICK!
KEEP EATING THAT HEALTHY CALCIUM!

Figure 5: Fact-based correction vs. logic-based correction (Vraga et al. 2020).

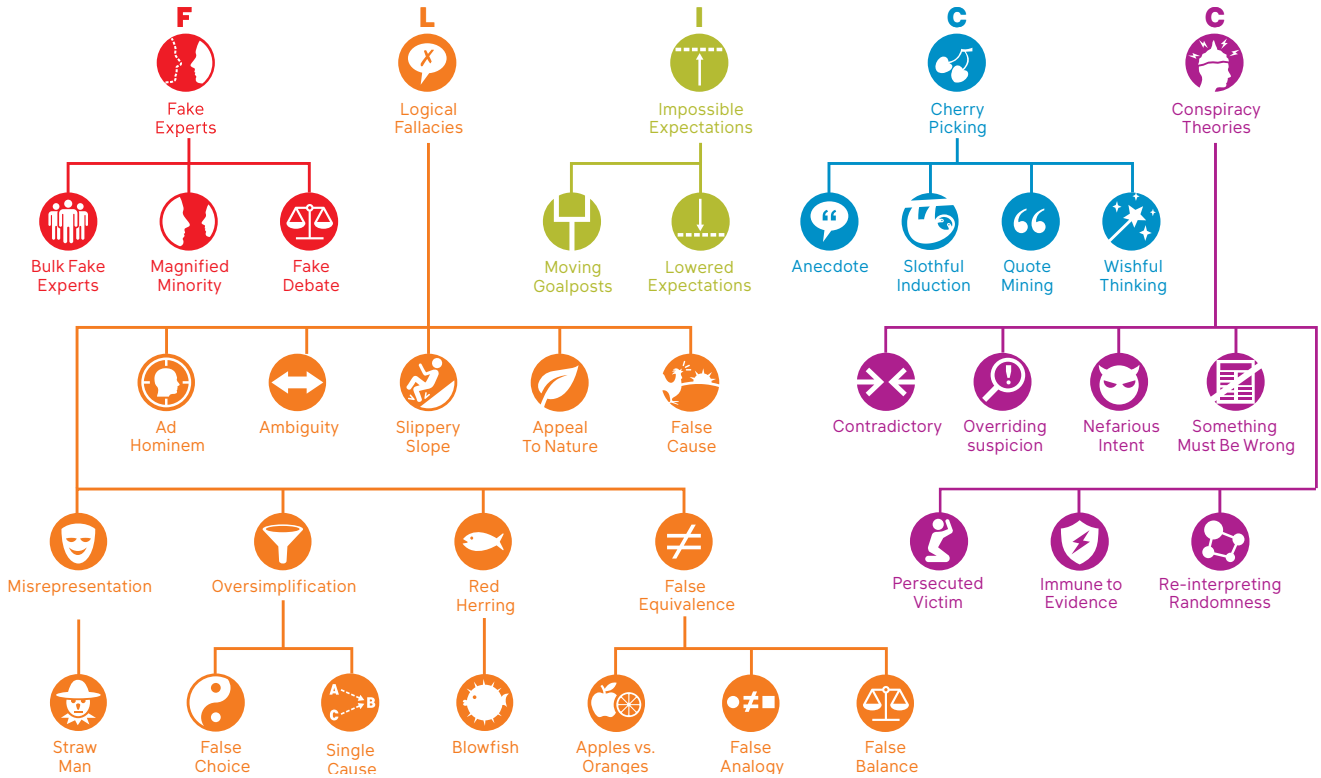

Figure 6: FLICC taxonomy, summarizing the five categories of science denial.

there are many techniques and fallacies to learn if we wish to develop resilience against misinformation (and the taxonomy isn't comprehensive; I continue to add more over time). How do you get the general public to learn all these techniques and internalize them deeply enough that they recognize them in real-world venues such as social media, mainstream media, and personal conversations?

To address this challenge, I turned to *gamification*. The advantage of games is you can use gameplay elements such as collecting points and leveling up to motivate players to progress farther into the game, which in the case of an educational game may serve to reinforce learning. In 2020, we ran a crowd-funding campaign to develop the *Cranky Uncle* game (Cook et al. 2022). See http://sks.to/cafe2 for a short video introduction (sequel to the original Critical Thinking Cafe video). After a successful campaign, we developed the game and released it free to the public, available on iPhone, Android, and browsers (crankyuncle.com).

Throughout the game, a cartoon character representing a science-denying cranky uncle explains how he casts doubt on science, running through the techniques in the FLICC taxonomy (Figures 7a and 7b). As players learn new techniques, they practice critical thinking via quizzes where they must identify the fallacy in misinformation examples (Figure 7c). Each time they answer correctly, they earn cranky points. When they level up, Cranky Uncle's mood gets a little crankier, from "sullen" to "huffy" to "peevish" and onward.

The advantage of the logic-based approach is it easily adapts to other topics because fallacies are found everywhere. Throughout the game, players are shown examples of fallacies from a variety of domains. A quiz giving an example of *cherry picking* might involve flat-earthism ("The world can't be round because the floor in this room is flat") or general fallacious logic ("I just ate a big meal; global hunger doesn't exist"). *Impossible expectations* quizzes could draw from evolution ("Until we find all missing links, we can't be confident of the theory of evolution") and vaccination ("We need more research before we can be 100% sure that vaccination is safe").

Conclusion

The effectiveness of the *Cranky Uncle* game, with its combination of facts and logic-checking, raises an important communication principle. We should avoid the false dichotomy (a fallacy found in the FLICC taxonomy) of thinking that we should either take a logic-based *or* fact-based approach. Ideally, we should try to use both. This is the approach recommended in the 2020 Debunking Handbook (Lewandowsky et al. 2020), where we suggest that debunkings should be arranged using the fact-myth-fallacy-fact structure, otherwise known as a "truth sandwich" (Figure 8). Debunkings should place the emphasis on facts rather than the myth. Unfortunately, many fact-checkers use the myth as their headline, placing undue emphasis on the misinformation rather than the facts.

When you debunk a myth, you create a gap in people's mental models and need to fill that gap with a "replacement fact," otherwise the myth will come back and continue to influence the person. Therefore, your fact needs to be carefully chosen to fill the gap left by the vacated myth (Johnson and Seifert 1994). For example, if you're debunking the myth that the Sun causes

Figure 7: Cranky Uncle game: a) FLICC fallacies; b) Explanation of conspiracy theories; c) Quiz question.

global warming, it's insufficient to merely explain how the Sun can't be causing global warming; you also need to explain what *is* causing global warming (which is the increased greenhouse warming from burning fossil fuels).

Once you've explained the fact, you can mention the myth (only once), while being careful to explicitly warn people that you're about to mention misinformation to put them cognitively on guard (Ecker et al. 2010). This can be something as simple as "One myth states …" or "Some people falsely claim …" But presenting fact and myth confronts people with two conflicting pieces of information. If they can't resolve the conflict between fact and myth, the danger is they cancel each other out (van der Linden et al. 2017). You resolve the conflict by explaining the fallacy that the myth uses to distort the facts. Finally, end the debunking by once again reinforcing the facts. This completes the truth sandwich, a seamless melding of fact-checking and logic-checking that is the most effective structure for a debunking.

Misinformation has exploded as a societal issue over the past decade, and the ways that it influences people are expanding in alarming ways through new technologies such as social media platforms and artificial intelligence. We need technology to respond at the speed and scale required. Consequently, I have been working on using AI to detect logical fallacies (Zanartu et al. 2024a). This is one component in our continued quest for the fact-checking holy grail—automatically debunking misinformation with AI generated truth sandwiches (Zanartu et al. 2024b).

But technology isn't a magic bullet that will solve all our problems. Misinformation is a multi-faceted, interconnected problem that requires a range of solutions—technological, cultural, political, legal, and educational. Part of the solution requires rolling up our sleeves and developing ways to boost people's critical thinking skills. Logic-checking alongside fact-checking gives us a more holistic and versatile set of tools to tackle the variety of misinformation that confronts us. ■

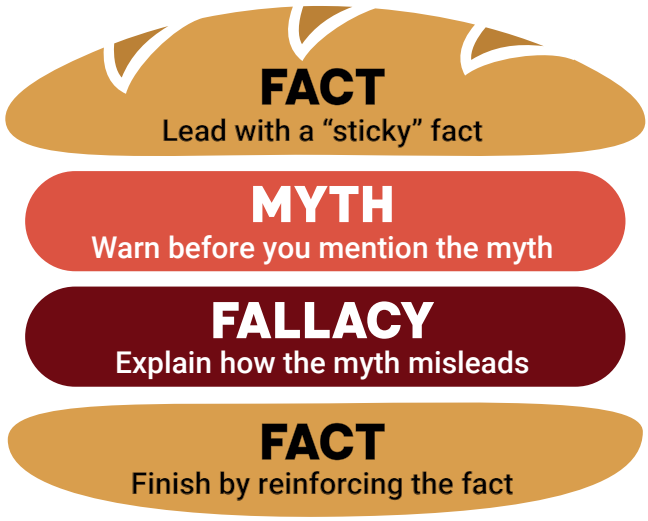

Figure 8: The truth sandwich format for debunking misinformation, adhering to the fact-myth-fallacy-fact structure (Lewandowsky et al. 2020).

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A Triple Threat to Humanity: Climate Change, Pandemics, and Anti-Science

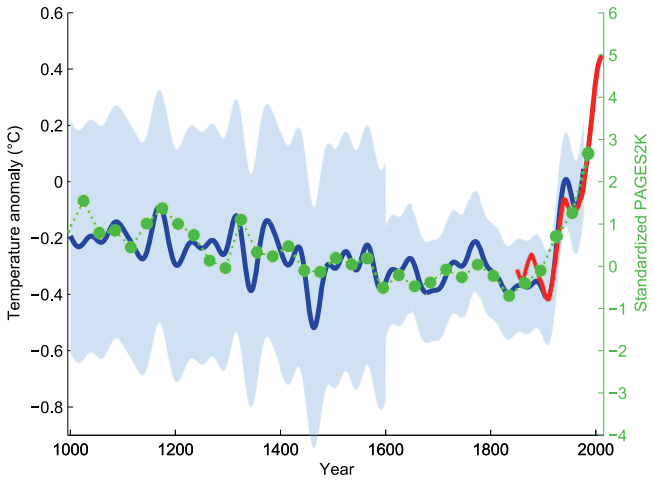
MICHAEL E. MANN AND PETER J. HOTEZ

Over the past decade, many of us in the scientific community have come to appreciate the existential threat we face today—a threat unlike any we've witnessed since the days of the U.S. and Soviet Cold War in the last half of the twentieth century. While even today the specter of nuclear annihilation remains, especially given the escalation of hot wars in Ukraine-Russia and Israel-Iran, we now face entirely new twenty-first-century forces that place the future of humankind in even greater peril.

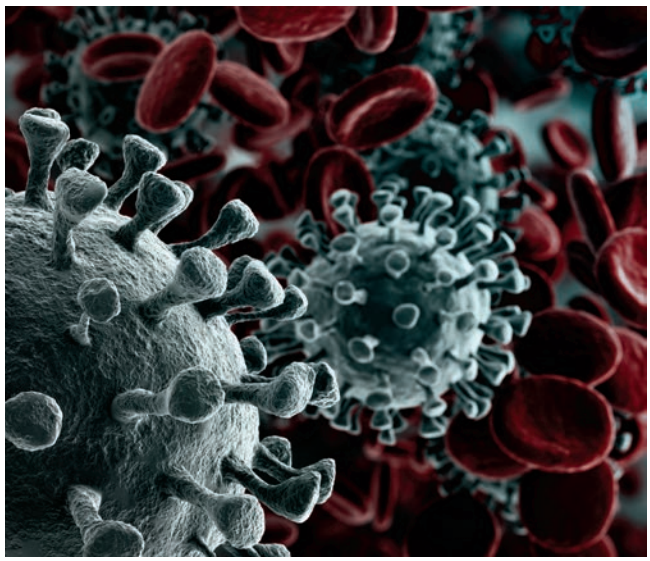
Our newest and gravest challenge may not feel as acute as the 1980s Cold War threat of mutual assured destruction (MAD). There are no missiles with nuclear warheads criss-crossing the oceans. But it is every bit as real, posing a threat to civilization and our planet. This NextGen MAD consists of three synergistic components.

The first component is the unprecedented warming of our planet and temperatures that one of us (Michael Mann) highlighted more than two decades ago while still a postdoctoral researcher in the form of the now-famous "hockey stick" curve. The warming of the planet and its impacts—which include coastal inundation from melting ice and intensified more deadly hurricanes, droughts, heat waves, and wildfires—is taking an increasing toll on our civilization by any measure, be it loss of life (which can be measured in millions of lives per year) or economic costs (which can be measured in trillions of dollars per year in lost GDP globally). Look no further than deadly temperatures that exceeded 50°C (122°F) this past summer. More than 2,000 Americans died from extreme heat in 2023, a tragic new record. The death and destruction will continue to accelerate as long as we fail to address the problem at its source: chiefly, our ongoing reliance on fossil fuels for energy and transportation.

A "hockey stick" description also applies to the new pattern or cadence of pandemic threats—the second component. One of the most common questions that one of us (Peter Hotez) is asked: "Hey doc, what the heck is going on?" Why are we seeing three major coronavirus global epidemics—SARS, MERS, and now COVID-19 (caused by SARS-2), or Ebola epidemics in West Africa in 2014 or in DR Congo in 2019? These viruses all originate from bats; a part of this accelerating cadence of pandemics may be shifts in bat habitats that bring them closer to humans in concert with expanding human populations in formerly forested areas due to urbanization. Similar expansions in urbanizations, together with climate change, also explains why we're seeing more mosquito-transmitted virus infections such as dengue or chikungunya and also parasitic infections such as malaria along the Gulf of Mexico, including in the United States (Hotez and LaBeaud 2023). This is also occur-



The famous "hockey stick graph" from Mann, Bradley, and Hughes (1999).



Our Fragile Moment
How Lessons from Earth's Past Can Help Us Survive the Climate Crisis
Michael Mann
THE DEADLY RISE OF ANTI-SCIENCE
A Scientist's Warning
PETER J. HOTEZ, MD, PhD

ring in southern Europe and elsewhere.

This brings us to the third and perhaps the most insidious component of all: a well-organized, financed, politically motivated, and steadily globalizing campaign of disinformation and attacks against mainstream science that makes it extremely difficult to mount an effective global response to the climate and pandemic threats. We witnessed an early instance decades ago as one of us (Michael Mann) described in his book *The Hockey Stick and the Climate Wars* when he and his colleagues came under vicious attack by forces linked to the oil and gas industry who viewed the hockey stick curve as a direct threat to their future profits and business ventures. As a pediatrician-scientist, Peter Hotez came under attack for his staunch defense of vaccines. Hotez's book, *Vaccines Did Not Cause Rachel's Autism*, about his youngest daughter, was a threat to a group that became known as the "disinformation dozen" (named by the Center for Countering Digital Hate, see also Nick Tiller's piece in SI's September/October 2022 issue), monetizing the internet through sales of nutritional supplements, spectacular cures, or anti-vaccine books on Amazon. Anti-vaccine activism took an even darker turn during the COVID-19 pandemic when more than 200,000 Americans needlessly perished because they refused COVID-19 vaccines during the delta and BA.1 omicron waves of 2021–2022. This occurred when the anti-vaccine movement fell under a new banner of "health freedom" in conservative circles.

Increasingly, we recognize how the forces behind the attacks on climate science and biomedicine (around vaccines and pandemics) have begun to converge. Unfortunately, they also include not only attacks on the science but also the scientists themselves. Tragically this even includes personal attacks from high-ranking public officials and even members of the U.S. Congress and U.S. Presidential candidates. They also include attacks from billionaires and the conservative media, especially Fox News and the *Wall Street Journal* editorial pages. However, even the mainstream media has increasingly helped spread anti-scientific disinformation and has platformed activists seeking to discredit both science and scientists.

In all, we have identified five major forces that have advanced attacks on science and scientists and promoted anti-science disinformation. We call them the "5 Ps," the plutocrats and petrostates (billionaires and state actors, respectively, who fund the attacks), the pros (the hired guns), the propagandists (industry shills and opportunists posing as experts), and—as we've already explained above—the press. Together they compose a coordinated, powerful, and formidable anti-science leviathan that threatens our future.

Although we are first and foremost researchers and academicians, this is far more than an arcane discussion for our faculty and students. Anti-science is now a lethal force that threatens human civilization. We can no longer fight climate change and pandemics unless we can find a means to defuse the anti-science bomb that threatens our future. So far, we are losing this battle. While time remains, the window of opportunity is beginning to close, and it is absolutely critical that we take action now. ■

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How Conservative Estimates of Climate Change May Destroy or Save the World

ERIC J. WARD

"We didn't expect this heating to happen so early in the year and to be so extreme," Derek Manzello, a coordinator at the National Oceanic and Atmospheric Administration's Coral Reef Watch, told CNN (Zerkel 2023). This is just one of many articles expressing surprise at worse-than-expected effects of global warming.

Scientists have been *systematically* underestimating the effects of climate change in their statements to the public. They apply scientific terminology to an engineering problem, leading us to evaluate the data inappropriately. I submit that the problem lies with the difference between how scientists and engineers use the term *conservative* in evaluating data.

The scientists' use of the term *conservative* is consistent with the definition "marked by moderation or caution" in that scientists are cautious not to allow uncertainty to inflate an estimate. This use of *conservative* is common in scientific presentations, such as "scientists have in fact been conservative in their projections of the impacts of climate change. In particular, we discuss recent studies showing that at least some of the key attributes of global warming from increased atmospheric greenhouse gases have been under-predicted" (Brysse et al. 2012). There are several reasons for this under-predicting, including science's aversion to drama (Scherer 2012), but our concern here is the effect of this bias.

Keynyn Brysse and colleagues were referring to the 2001 IPCC report, including its estimate of 0.11 to 0.77 m (4.3 to 30.3 in) of sea level rise by 2100 (Houghton et al. 2001). This estimate included only -0.02 to 0.09 m from Greenland ice melting and -0.17 to 0.02 m from Antarctica. Brysse and colleagues called these estimates "conservative" and "under predicted." In light of the 1995 collapse of the Larsen A ice shelf (Fox 2012) and the 1996 ice dam break in Iceland (Schoonmaker 1998), this estimate seemed ridiculously small to me at the time. In the 2021 report, the estimate rose to 0.28 to 1.01 m (11.0 to 39.8 in) but still included "only likely ranges due to difficulties in estimating the distribution of deeply uncertain processes" (Masson-Delmotte et al. 2021).

With thirty-five years of experience designing Pratt and Whitney jet engines, I can tell you that engineers use the term *conservative* quite differently. We also consider it to mean "marked by moderation or caution," but we apply this caution to the success of the project as a whole. Therefore, our *conservative* designs are based on worst-case scenarios rather than the best-case ones

that the scientists project.

A jet engine must operate under severe conditions, but early in the design process, the design parameters are only rough estimates. A conservative approach is taken, where the worst possible values for each parameter are assumed. It is initially assumed that these values peak simultaneously in the flight mission, which is seldom the case. As the design proceeds, uncertainty decreases, allowing changes in the design to reduce weight and cost.

The process rarely follows a smooth, linear course. Sometimes it is found that a value is higher than estimated, requiring a difficult redesign. At other times, the uncertainty is too large to accommodate with a reasonable design. In those cases, engineering judgment is used to estimate the most likely value. The design proceeds while recognizing the increased risk until accurate values are obtained. In addition, safety factors are added and retained even as uncertainty decreases. The design is also subjected to reviews by experienced engineers.

Even so, there may be unknowns that cause a parameter to exceed the expected range or cause a failure through an unanticipated phenomenon. This is why there are thousands of hours of ground testing before an engine design is allowed to fly. This method of conservative design has resulted in an extremely high level of reliability in today's jet engines.

Imagine taking the opposite approach: Design an engine using the best-case (i.e., least severe) estimates for each parameter. Omit the safety factors and chiefs' reviews. Put the untested engine into a plane full of passengers and send them on their way. This would not be considered "conservative" by engineers; it would be reckless. It would virtually assure disaster—and it is

analogous to our approach to addressing sea level rise.

Consider the 2001 estimate of a sea level rise of about thirty inches by 2100 (Houghton et al. 2001). That was a conservative estimate, with scientists cautious not to overestimate the value. Glenn Scherer noted that the actual sea level rise from 1993 to 2006 exceeded the IPCC estimates by over 50 percent and indicated that the next report may be even more conservative. These low estimates gave the impression that there was not much to be concerned with. That made it easy for the energy corporations and their lackeys in government to block actions from being taken.

Let's now assume that it is 2001 but take an engineer's conservative approach. The largest factor is the melting of the glacial ice (Lindsey 2022), but we do not know how to accurately calculate how much will melt by 2100.

If we were to assume that all the ice would melt, we would get a rise of about 230 feet (USGS.gov n.d.). However, it may take centuries to melt all that ice, and hopefully we can curb our output of greenhouse gasses long before then. A more realistic approach would be to ask, "What is the *maximum* amount of rise we are likely to get by 2100?" That value would be based on rough calculations tempered by the judgment of experts. A safety factor would be added to protect our estimate from unknown factors. I suspect that an estimate made at the time using this methodology would have come to twenty to thirty feet, but I have never seen such a calculation presented.

Rather than the false sense of security and inaction, this would have sparked a call for action. As time passed, the uncertainty would have been reduced, lowering the estimate. I would expect that using this method, the current estimate would be between ten and twenty feet. I would like to see an estimate by the experts made this way disseminated to the public.

Those benefiting from inaction label this approach as "scare tactics." It is not; it is instead the same conservative approach that makes today's air travel so safe. We are allowing the energy companies to lead us onto that airplane equipped with untested engines based on best-case conditions with no safety factor or review.

The scientists' practice of caution in reporting results has served them well in most instances. In theoretical matters, deliberation and restraint serve to prevent error. But in this highly politized issue where time is of the essence, the scientists' conservative estimates have abetted those who wish to delay needed actions.

Accepting the engineers' conservative approach would greatly improve our ability to avoid the most severe consequences of sea level rise, but this requires facing inconvenient truths. In accepting the true magnitude of this problem, we find the "every little bit helps" approach severely inadequate. Major efforts are required to avoid catastrophic disruption of society. These include actions to reduce the warming of the oceans and mitigations of the sea level rise.

These mitigations are very difficult and expensive. Many have been proposed, including moving millions of people away from shore (Dawson 2022), construction of vertical farms (Climate Adaptation Platform 2022), and reverting large parcels of land back to nature (Huber 2022). Also, unpleasant decisions must be made. For example, a sea level rise of ten feet will wipe out most of the Florida Everglades. Perhaps our talk of "preserving the Everglades for all future generations" may be unrealistic. Instead, should we ask if it is worth spending billions of dollars to maintain it until its pending doom or if limited funds are better spent elsewhere? I do not like asking this, and I do not know what the best answers are. I do know that if we do not face these issues, money will be spent, but the disaster will not be averted.

Guest editor's note: Mr. Ward may be right. It may also be that both climate scientists and engineers have been compelled to downplay the threat and speed of climate change to get any sort of worthwhile language into reports such as those issued by the IPCC. As Upton Sinclair repeated during his campaign for governor: "It is difficult to get a man to understand something, when his salary depends on his not understanding it." Same may be true of whole countries, where the economy is believed to be dependent on fossil fuel burning. ■

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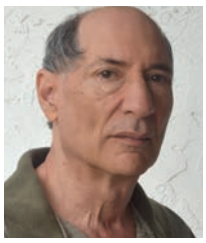

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Sea Level Rise Science and Communication Are Hard but Keep Improving

JOHN R. MASHEY

In this issue of Skeptical Inquirer, Eric J. Ward writes that sea level rise (SLR) is a threat, that scientists' predictions—especially via the Intergovernmental Panel on Climate Change (IPCC)—have been too conservative, and that it would be better to promote worst-case analyses like jet engineers do.

SLR is indeed a serious threat, especially given anti-science claims by politicians (Dale 2024), state laws against using best science (Allen 2020), and even deletion of climate change from state laws (Nilsen 2024). All play to popular wishes to live near oceans, economic rewards for building there, and existing investments in coastal infrastructure. Many prefer wishful thinking over science.

However, even hard engineering projects are less complex than forecasting SLR values and their uncertainties and then communicating them to public groups who need localized information. Adaptative strategies depend on risk tolerance, planning horizons, economies, and politics, as I saw at a workshop titled "Preparing for Sea Level Rise in the Bay Area" (San Francisco Bay Conservation and Development Commission 2008). After reviews of science and potential actions, we were given imaginary town descriptions and asked to plan for decades. It was hard.

Famed climatologist Stephen Schneider (Frazier and Casten 2010) often promoted quantification and explanation of uncertainty. He also wrote how strong statements from scientists' IPCC full reports often softened in Summaries for Policymakers, where all countries must agree on every word (Schneider 2009). All IPCC reports are online (IPCC 2024).

Ward mentions an oft-cited paper (Brysse et al. 2012) that covered general reasons for conservative scientific estimates and highlighted SLR's biggest uncertainty: potential disintegration of the West Antarctica Ice Sheet (WAIS). IPCC (2001) called this unlikely, but as new data emerged, IPCC (2007) later said, "The state of understanding prevents a best estimate from being made." Scientists were hardly ignoring the issue. For example, I attended one of the American Geophysical Union's stimulating workshops on uncertainty (American Geophysical Union 2012).

IPCC kept progressing and the history is well-summarized in a fine recent review by seventeen SLR experts (Kopp et al. 2023). *Unquantifiable uncertainty* refers mostly to WAIS collapse:

> Future sea-level change is characterized by both quantifiable and unquantifiable uncertainties. Effective communication of both types of uncertainty is a key challenge in translating sea-level science to inform long-term coastal planning. Scientific assessments play a key role in the translation process and have taken diverse approaches to communicating sea-level projection uncertainty. Here we review how past IPCC and regional assessments have presented sea-level projection uncertainty, how IPCC presentations have been interpreted by regional assessments and how regional assessments and policy guidance simplify projections for practical use. This information influenced the IPCC Sixth Assessment Report.

Table 1 in the review on SLR ice-sheet contributions illustrates 1990–2021 progress. Robert Kopp cites several regional assessments (California State Lands Commission 2018, 18) and projects SLR at twelve coastal tide gauges by decade from 2030 to 2150 under various emissions scenarios plus the wildcard WAIS collapse (over three meters [10.2 feet] by 2100). It then advises strategies based on risk aversion level: low, medium, and extreme (WAIS collapse).

Overall, IPCC reports increasingly identify unquantifiable uncertainties, as scientists continue research to better bind them. Meanwhile, regional organizations have been incorporating these ideas for years. Although anti-science forces try to downplay SLR, science is not ignoring it—but the problem remains complex. ■

Due to space limitations, references can be found in the online version of this article at skepticalinquirer.org.

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Unmasking the Claims of the Antinuclear Movement: Climate, Health, and Energy at the Crossroads

AMARDEO SARMA

The global population is predicted to reach just above ten billion in the 2080s (United Nations 2024) before it starts to fall, which sets targets for all of us. That is the number we need to feed and provide affordable and reliable energy.

We have learned that many of our benefits, which give us a better life than ever, have also come at a cost. Looking at energy production, we have seen that burning fossil fuels brought us prosperity but has come with increased carbon emissions and particulate matter. The former has long-term effects on the climate, and the latter has immense health implications now.

Therefore, it is no surprise that we now aim to achieve industrialization's benefits with as few side effects as possible. The goal is to remove fossil fuels while maintaining their benefits through alternatives that provide similar benefits at a lower cost to our planet and health.

While energy has many components, such as steel and cement production, heating, transportation, and agriculture, this article focuses on electricity generation. Though it makes up less than 30 percent of current energy use, its share is expected to increase (IEA 2024) and can be an example for other sectors that move toward electrification.

Some have opted to choose all low-carbon options when choosing the way forward. In contrast, others have tried to ban some alternatives to focus on "renewable" energy only. Here, we examine the myths used to exclude or even ban nuclear energy.

Background

When making decisions, we must always balance the benefits we get and the risks we accept. So, what role should nuclear power play?

In the 1950s, nuclear power was hailed as an excellent and

affordable energy source. Lewis L. Strauss, the chairman of the U.S. Atomic Energy Commission, said in a speech given to the National Association of Science Writers in 1954 that he was hopeful of "electricity too cheap to meter" (Strauss 1954) in the long run.

During the 1970s and 1980s, a significant shift occurred in the global discourse. Climate issues had not entered mainstream discussions while the antinuclear movement gained substantial traction (Rothwell n.d.; Mills and Williams 1986). Later, as environmental concerns escalated, the spotlight was primarily on renewable energy sources, with nuclear power being perceived as a perilous option.

Given today's problems, we must compare all energy sources based on facts, thereby understanding the implications for our climate, environment, and energy security, and overall prosperity.

There are plenty of examples of rational assessments of all available low-carbon energy options (UN News 2021). An informed approach is essential to achieving our self-set goals. Diversifying our energy sources for global energy security bolsters resilience and mitigates the risk of single points of failure of one kind of electricity generation. Renewables are becoming cheaper and play a significant role in many countries, but they suffer from intermittency. In contrast, nuclear power offers a reliable and abundant energy source. This shows that a balanced comparison of benefits and risks is needed for all energy sources and combinations, and that balance may differ from region to region.

Nuclear fear and the denial of its benefits (Weart 2012) remain barriers, so we need to examine the myths surrounding it.

The other issue arising in the past forty years is anthropogenic global warming, for which the Intergovernmental Panel on Climate Change (IPCC) was established. Between 1990 and 2021, the IPCC released six assessment reports and several special reports that described the current state of greenhouse gases in Earth's atmosphere, trends in greenhouse gas emissions, and their likely effects on atmospheric processes, economies, and ecosystems.

In its sixth assessment report, the IPCC showed the contributions of various kinds of human activity to temperature forcing, including the uncertainties involved. Carbon dioxide is the most significant driver. The Earth has warmed more than 1°C since industrialization, with anthropogenic emissions as the primary cause. We have a particular responsibility to reduce carbon dioxide emissions, because this gas lingers in the atmosphere much longer than others (Archer 2016).

The IPCC has also included nuclear power in all its pathways to reduce the carbon impact and thus on temperatures. So, let us examine some reasons for excluding nuclear power from our considerations.

Claim #1: Nuclear Power Is Not Carbon-Free

Scientists such as Mark Jacobson deny that nuclear power is low carbon: "First, it's not carbon-free, no matter what the advocates tell you. Vast amounts of fossil fuels must be burned to mine, transport and enrich uranium and to build the nuclear plant. And all that dirty power will be released during the 10 to 19 years that it takes to plan and build a nuclear plant. (A wind farm typically takes two to five years.)" (Jacobson 2010).

Jacobson fails to mention that no energy source, including renewables, is entirely carbon-free. So, how do energy sources compare regarding lifetime carbon emissions? That is the question we must answer.

Michaja Pehl et al. (2017) did the work and compared the alternatives. They show that solar, wind, and nuclear power all have remarkably low (not zero) carbon footprints. When the entire lifecycle of these energy sources was considered regarding direct and indirect greenhouse gas emissions, the results were unequivocal: solar, wind, and nuclear power showed comparable emissions levels, all significantly lower than traditional fossil fuel sources.

Claim #2: Nuclear and Renewables Do Not Work Together

Another often-made claim is the incompatibility of wind and solar with nuclear, leading to the assertion that we must decide on one or the other, mostly in favor of wind and solar. This relates to the need to have a backup for solar and wind when the weather conditions do not fit, which, as an aside, is not a problem for nuclear power. The consequence of this assumption is that we will continue to have a lot of fossil fuel emissions until the non-nuclear backup solutions become available in scale.

In her 2022 book, Anna Veronika Wendland points out that modern nuclear power plants are well equipped to adapt and follow load. She writes: "Suppose a nuclear power plant with a rated output of 1,400 megawatts ramps up and down between 1,000 and 1,400 megawatts with a 1.5 to 3 percent gradient, i.e., at 20 to 30 megawatts per minute. In that case, it makes the same contribution to grid stabilization as a fast gas turbine with 300 megawatts" (Wendland 2022).

Wherever gas plants are used as a backup, which is German policy, nuclear power could do the same, but with much fewer emissions. We can see what German policy has led to by comparing Germany with France on emissions. The numbers from sources such as the electricity map at https://app.electricitymaps.com/ show that those who bet on nuclear, hydro, geothermal, or a combination fare best. It also shows that countries such as Finland that have built more nuclear power plants have improved, while Germany has continued to have high emissions over the years. They only substitute one low-carbon source with another instead of phasing out of fossil fuels.

Claim #3: Nuclear Is Too Slow

Some have expressed concerns about the time it takes to implement large-scale projects such as nuclear power plants, emphasize the urgency of implementing climate solutions, and "warn" against being distracted by "solutions" that might work down the road but take too long to implement.

Recent data contradicts this claim. In 2022, the median construction time for nuclear reactors connected to the grid

was eighty-nine months, or almost 7.5 years (Ritchie 2023). The mean was even lower at 6.3 years. For new reactor designs, the average construction time was double the projected schedule, taking over 100 months, but these can also be expected to go down with experience.

The other problem is that comparing nuclear power plants with solar and wind energy cannot be restricted to building these. As intermittent sources, they need compensation when weather conditions do not allow electricity production, traditionally fossil fuels.

Yes, we need to invest in hydrogen and battery solutions, but these, too, require time to install and scale well beyond the 7.5 years needed to build nuclear power plants.

Claim #4: Nuclear Is Too Expensive

The "too expensive" argument is mainly based on Lazard's Levelized Cost of Energy (LCOE) model, which compares the costs of different energy sources but has severe limitations when comparing nuclear energy and renewables, particularly regarding capacity factor and the need for backup and infrastructure for renewables.

The capacity factor of an energy source is the ratio of its actual output over a period to its potential output if it were possible to operate continuously at full capacity. The model fails to account for the significant differences in capacity factors between nuclear and renewable energy sources. Nuclear power plants have high-capacity factors because they can operate continuously. In contrast, renewable sources such as wind and solar have lower capacity factors due to their intermittent nature. The Sun does not always shine, and the wind does not always blow. Nuclear runs well over 90 percent of the time.

Solar and wind require both backups, a substantial energy storage, and a transmission infrastructure. The LCOE model does not account for these costs. LCOE estimates for dispatchable and non-dispatchable electricity sources are not an apples-to-apples value comparison, because wind and solar cannot supply reliable power on demand like dispatchable energy sources.

Fraunhofer ISE (2024) is an example of massaging data to make nuclear power look even worse than lignite. As the owner of the site Tech for Future Florian Blümm points out, nuclear has been made to look bad by distorting the numbers for capacity factor (23–73 percent instead of 90 percent), overnight costs of up to 16,000 euros instead of around 4,000 euros, and a lifetime far less than what modern nuclear power plants are planned for.

Besides these considerations, thinking the climate crisis can be solved quickly is an illusion. Despite all the programs in place to achieve these goals by arbitrary dates such as 2040 or 2050, we are faced with a problem that would be an outstanding achievement to solve in this century.

Claim #5: We Do Not Have Enough Uranium

This is a sustainability argument that nuclear power plants will run out of fuel soon. Is this correct?

The recent annual production of natural uranium worldwide has been between 55,000 and 65,000 tons of uranium

A leftover, open-pit Uranium mine.

metal, which is the fuel demand.

However, the availability of uranium extends beyond the conventional mining of uranium ore. A significant amount of uranium can be recovered from spent nuclear fuel. Spent nuclear fuel, which is nuclear fuel that has been irradiated in a nuclear reactor, contains about 96 percent reusable material. Approximately 3–4 percent of the heavy nuclei are fissioned in a nuclear reactor, with about two-thirds of these fissions coming directly from uranium-235 and the other third from plutonium produced from uranium-238. This indicates that uranium-238 in spent fuel can be utilized as a source of nuclear fuel, extending the availability of uranium.

In addition to spent fuel, new extraction methods have made it possible to obtain uranium from seawater. The Nuclear Energy Agency estimates that 4.5 billion tons of uranium are floating around our oceans as dissolved uranyl ions. This reserve is over 1,000 times more than what's on land. Extracting these ions involves dipping plastic fibers containing amidoxime into seawater. The uranyl ions essentially stick to the amidoxime. This method has been shown to extract 12.6 milligrams of uranium per gram of coated, active material over twenty-four days.

While the cost of extracting uranium from seawater is currently higher than that of mining uranium ore, the cost of uranium is a small percentage of the cost of a nuclear power plant. Even with the higher ocean extraction costs, the fuel cost in nuclear power plants would remain a minor cost factor.

Using uranium-238 in spent fuel and new extraction methods from seawater ensures that nuclear power remains a viable and sustainable energy source for the future (Shabbir at al. 2024).

Claim #6: Nuclear Power Is Dangerous

Much of the fear of nuclear power stems from the fear of radiation, among them the claim that even minute amounts of radiation cause damage. There have been claims that even living near nuclear power plants is dangerous.

The surplus radiation around nuclear power plants is far below the difference in natural radiation between any two places. We forget that coal power plants pose a significantly higher radiation threat. The U.S. Department of Energy, Office of Scientific and Technical Information, writes, "Policymakers should look at the data and recognize that the amount of uranium-235 alone dispersed by coal combustion is the equivalent of dozens of nuclear reactor fuel loadings" (Gabbard 1993).

Two examples of how nuclear fear has been blown out of proportion are the Chernobyl and Fukushima nuclear accidents. Undoubtedly, the Chernobyl and Fukushima nuclear accidents were disasters for the local populations due to large-scale evacuations and psychological distress.

In 1986, the Chernobyl disaster caused the deaths of thirty workers within a few weeks and radiation injuries to over a hundred others (UNSCEAR 2008). The authorities evacuated about 115,000 people from areas surrounding the reactor and relocated about 220,000 people from Belarus, the Russian Federation, and Ukraine. The accident caused severe social and psychological disruption in the lives of those affected and vast economic losses over the entire region.

Similarly, the Japanese government implemented protective measures in Fukushima, evacuating people and halting food shipments (NEI 2012). While the limited radiation release at Fukushima allowed for rapid repopulation, lingering radiation at both Chernobyl and Fukushima has prevented complete resettlement. At Chernobyl, due to the severity of the release, a thirty-kilometer radius was evacuated and remains largely unpopulated. At Fukushima, however, a radiation threshold of twenty millisieverts per year was used to determine the need for evacuation.

Notably, both accidents would have been avoided if *already existing safety measures* had been followed. The Chernobyl accident stemmed from a flawed reactor design and human error. The safety measures at Fukushima did not account for the worst possible natural disaster that should have been expected, contributing to the accident's severity.

In the aftermath of these accidents, nuclear safety measures have been reassessed and strengthened, including carrying out "stress tests" to reassess the design of nuclear power plants against site-specific extreme natural hazards. These accidents are a stark reminder of the importance of rigorous safety measures that should be on paper and followed strictly in practice and disaster preparedness in the operation of nuclear power plants.

Our World in Data has compared the deaths caused by various energy sources. The figures include the death toll from Chernobyl and Fukushima.

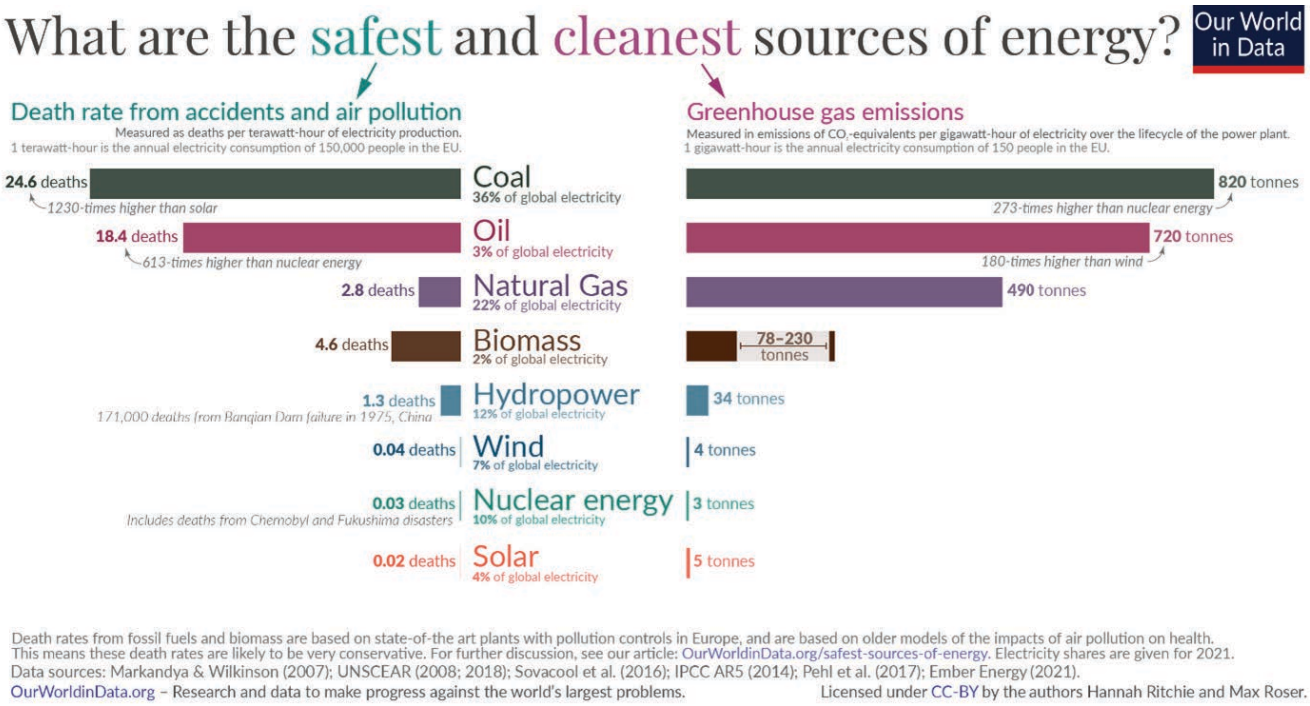
On a global scale, nuclear, wind, and solar are comparable for emissions and deaths. So, where does the confusion come from?

For Chernobyl, the resulting deaths have been vastly exaggerated. The Union of Concerned Scientists and the Torch Report claim deaths in the tens of thousands in the long term, but the current number of reported deaths due to the disaster is in double digits. The UN estimates that only fifty deaths can be directly attributed to the disaster. In 2005, the WHO predicted a further 4,000 might eventually die because of radiation exposure.

Little known is that wildlife has returned to the Chernobyl Exclusion Zone. Over the years, the absence of human activity has allowed the area to become a thriving ecosystem. This astonishing resurgence has been attributed to a combination of factors, including reduced human presence, the absence of hunting, and the lack of agricultural activity. In essence, the area has become one of the largest nature reserves in mainland Europe, showcasing nature's resilience.

While the Fukushima disaster was undoubtedly a grave incident, it is crucial to recognize that nobody except for a single controversial case died because of radiation (Sarma and Wendland 2021). Evacuations at the time may have exceeded what was required, creating unnecessary panic and fostering misconceptions about the actual consequences of the accident.

In contrast, the shutdown of nuclear power plants has led


What are the safest and cleanest sources of energy?
Our World in Data
Death rate from accidents and air pollution
Measured as deaths per terawatt-hour of electricity production.
1 terawatt-hour is the annual electricity consumption of 150,000 people in the EU.
Greenhouse gas emissions
Measured in emissions of CO₂-equivalents per gigawatt-hour of electricity over the lifecycle of the power plant.
1 gigawatt-hour is the annual electricity consumption of 150 people in the EU.
24.6 deaths
1230-times higher than solar
Coal
36% of global electricity
820 tonnes
273-times higher than nuclear energy
18.4 deaths
613-times higher than nuclear energy
Oil
3% of global electricity
720 tonnes
180-times higher than wind
2.8 deaths
Natural Gas
22% of global electricity
490 tonnes
4.6 deaths
Biomass
2% of global electricity
78–230 tonnes
1.3 deaths
171,000 deaths from Banqiao Dam failure in 1975, China
Hydropower
12% of global electricity
34 tonnes
0.04 deaths
Wind
7% of global electricity
4 tonnes
0.03 deaths
Includes deaths from Chernobyl and Fukushima disasters
Nuclear energy
10% of global electricity
3 tonnes
0.02 deaths
Solar
4% of global electricity
5 tonnes
Death rates from fossil fuels and biomass are based on state-of-the art plants with pollution controls in Europe, and are based on older models of the impacts of air pollution on health.
This means these death rates are likely to be very conservative. For further discussion, see our article: OurWorldinData.org/safest-sources-of-energy. Electricity shares are given for 2021.
Data sources: Markandya & Wilkinson (2007); UNSCEAR (2008; 2018); Sovacool et al. (2016); IPCC AR5 (2014); Pehl et al. (2017); Ember Energy (2021).
OurWorldinData.org – Research and data to make progress against the world's largest problems.
Licensed under CC-BY by the authors Hannah Ritchie and Max Roser.

to thousands of premature deaths due to increased air pollution from burning fossil fuels instead, exceeding the number of deaths caused by nuclear power by orders of magnitude (Kharecha and Sato 2019).

The panic surrounding the release of contaminated water from the Fukushima power plant is another example of radiation fear. It illustrates a misunderstanding of radiation and its possible effects on human health and life.

Claim #7: There Is No (Good) Solution to Nuclear Waste

Nuclear waste is often used to describe spent nuclear fuel that is no longer efficient in conventional nuclear reactors. However, a more accurate term for this material is *used nuclear fuel* because it can still be utilized. Fast reactors, advanced nuclear reactors, are designed to use this fuel efficiently. Although not yet widely used, they can extract more energy from the used fuel, reducing the volume of waste and the time it needs to be stored.

Further, over hundreds of years, the substances in used nuclear fuel that emit harmful gamma radiation decay significantly. The more radioactive waste components are, the faster they decay. This reduces the risk to humans near the used fuel with time, even without shielding.

We do have substances that emit beta and alpha radiation in used nuclear fuel. These types of radiation are less penetrating than gamma radiation and can be blocked by a sheet of paper or human skin. To be harmful, they must be ingested or inhaled.

It is also not true that no solutions exist. Onkalo, a deep geological repository in Finland, is designed to store used nuclear fuel safely for up to 100,000 years. Deep geological repositories such as Onkalo pose an insignificant risk to those living there. The safety of solutions such as in Onkalo is evaluated using sophisticated computer models and is subject to rigorous regulatory oversight. Other countries are also developing repositories.

Claim #8: Nuclear Power Plants Lead to Nuclear Bombs

While nuclear power plants and nuclear weapons both involve nuclear reactions, they serve fundamentally different purposes and require different technologies and materials.

They require different enrichment levels: The uranium used in nuclear power plants is typically enriched to about 3–5 percent Uranium-235. On the other hand, the uranium used in nuclear weapons needs to be highly enriched, typically over 90 percent Uranium-235, to achieve the rapid chain reaction required for a nuclear explosion. The process to achieve this level of enrichment is technologically complex and resource intensive.

Also, the technology used to build a nuclear power plant differs from what is needed to build a nuclear weapon. The design, materials, and expertise needed are significantly different.

Nuclear power plants are also subject to international regulations and inspections by the International Atomic Energy Agency (IAEA) to ensure they are not used for military purposes. These inspections provide a level of transparency and security that makes it difficult for a country to covertly develop nuclear weapons under the guise of a civilian nuclear power program.

History has also shown that the presence of a nuclear power program does not necessarily lead to the development of nuclear weapons. Countries such as Sweden have nuclear power plants but no nuclear weapons, while North Korea developed nuclear weapons without having a significant nuclear power program.

Nuclear power plant in Barsebäck, Sweden

Developing nuclear weapons requires a significant diversion of resources, breach of international law, and a different set of technologies and expertise. The connection between nuclear power plants and nuclear weapons is very weak (see chapter 5 of the book *Nuclear Is Not the Solution* for counterarguments regarding this claim).

At the Crossroads

The safety of nuclear power plants is continuously being improved (IAEA 2014). NGOs (Greenpeace n.d.) and even scientists continue spreading nuclear fear. But there is also hope with the emergence of new, science-based NGOs (WePlanet 2024).

We already have many solutions to address climate change, health hazards due to particulate matter, and energy security. If we are serious about all this, we cannot afford blinkers on solutions such as nuclear power. We must use the best of science and technology and invest in future solutions that we will need well into the twenty-second century.

Guest editor's note: After visiting a nuclear plant a few years ago, I had no trouble imagining the trouble a bad guy, a confederate inside the plant, could cause if the confederate played the long game. If he or she worked there quietly for five or six years, this person might manage to smuggle or help forcibly extract some nuclear material suitable for an improvised bomb. If one day there are thousands of nuclear plants, rather than a few hundred, this could be big trouble. But perhaps all that would be required is more security, which would be as construction contractors say, "just a matter of cost," adding a few cents to per mega-Watt-hour of electricity. ■

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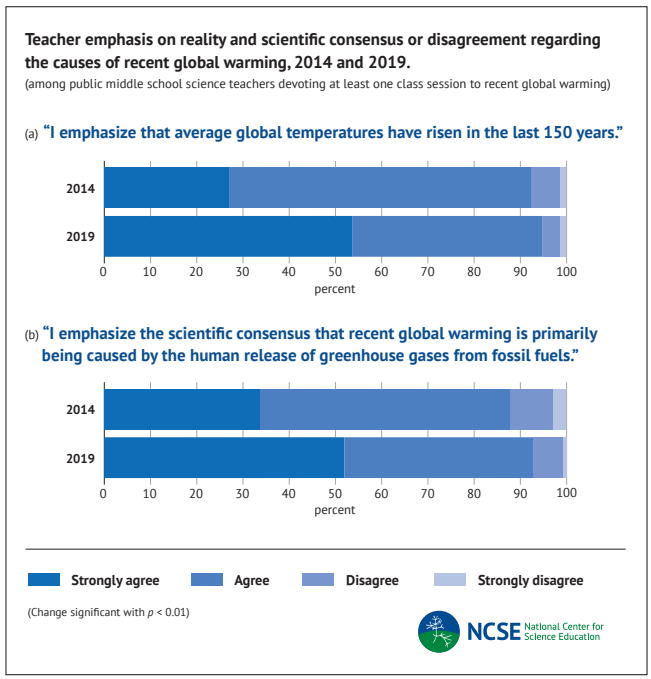
Amardeo Sarma is the CSI representative in Europe, a CSI fellow, and a member of the CSI Executive Council. He is founder and former chairman of the German skeptics organization GWUP. He has been involved in industrial research for more than thirty-five years. Sarma is managing director of the nonprofit company Scientific Temper, which is registered in Germany.

A Break in the Weather for American Middle School Climate Education

GLENN BRANCH


Teacher emphasis on reality and scientific consensus or disagreement regarding the causes of recent global warming, 2014 and 2019.
(among public middle school science teachers devoting at least one class session to recent global warming)
(a) "I emphasize that average global temperatures have risen in the last 150 years."
2014
2019
0 10 20 30 40 50 60 70 80 90 100
percent
(b) "I emphasize the scientific consensus that recent global warming is primarily being caused by the human release of greenhouse gases from fossil fuels."
2014
2019
0 10 20 30 40 50 60 70 80 90 100
percent
Strongly agree
Agree
Disagree
Strongly disagree
(Change significant with p < 0.01)
NCSE National Center for Science Education

More American public middle school science teachers are teaching, and teaching more about, recent global warming, although more of them are also giving "equal time" to doubts that recent global warming is human-caused, according to a new study I coauthored with Eric Plutzer, a political scientist at Penn State University, and Amanda L. Townley, the executive director of the National Center for Science Education.

Published in June 2024 in a special climate change education issue of the peer-reviewed *Journal of Microbiology & Biology Education*, the study ("Climate Change Education in U.S. Middle Schools: Changes over Five Pivotal Years") compared the results of two nationally representative surveys of public middle school science teachers in the United States from 2014 and 2019.

Why focus on middle school? Although there are opportunities to study climate change in high school biology, chemistry, and physics classes, the course most hospitable to climate change is high school earth science. But such classes are few and far between; according to a 2018 study, only eight states required the study of earth and space science concepts at the high school level. Consequently, middle school is the last stage in the formal education of perhaps most Americans in which a relatively extensive study of climate change might be expected. Improvements in climate change education at the middle school level are thus particularly welcome.

The study found that there were improvements in quantity between 2014 and 2019. In the earlier survey, 30 percent of middle school teachers reported not teaching about recent global warming at all, as opposed to only 24 percent in the later survey. While teachers who taught about recent global warming devoted 4.4 class hours on average to it in the earlier

survey, that was up to 6.5 class hours in the later survey. These are significant and substantial improvements.

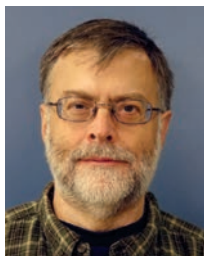
The study also found that there were improvements in quality. Significantly more teachers expressed strong agreement that they emphasized the reality of recent global warming (rising from 27 percent to 54 percent) and significantly more teachers expressed strong agreement that they emphasized the scientific consensus on its human causes (rising from 34 percent to 52 percent). There was not, however, any change in the proportion of teachers who reported emphasizing, misleadingly, that many scientists believe recent increases in temperature are likely due to natural causes.

There was also a bit of deterioration. Regarding ways of managing potential controversy in the classroom, there was a rise in the proportion of teachers who reported giving time to perspectives that raise doubt that humans are causing climate change, from 35 percent in 2014 to 43 percent in 2019. Presenting such perspectives is discouraged by scientific and science education organizations; the National Science Teaching Association, for example, recommends that science educators "emphasize to students that no scientific controversy exists regarding the basic facts of climate change."

Why the shift? The study analyzed a variety of possible factors. At the individual level, there was evidence that increasing acceptance of the scientific consensus on recent global warming on the part of the teachers was a factor. In 2014, 67 percent of the teachers accepted anthropogenic global warming themselves; five years later, 76 percent did. In 2014, 30 percent of the teachers estimated, correctly, that between 81 and 100 percent of climate scientists accept anthropogenic global warming; five years later, 45 percent did. These increases account for a substantial number of the improvements.

At the systemic level, the increasing presence of recent global warming in state standards was particularly important. The Next Generation Science Standards (NGSS), which treat global climate change as one of four sub-ideas in the core idea of earth and human activity at the middle school as well as at the high school level, were released in 2013, and the study found that "teacher attention to climate change—as reflected in the number of class hours devoted to the topic—increased most sharply in states that adopted the NGSS or [similar] standards … just before the first wave of the survey."

Every student deserves the chance to understand that there is a broad and deep scientific consensus on climate change's reality and causes. And although there's obviously room for further improvement, such a substantial shift at the crucial middle school level in a mere five years is encouraging. ■



Glenn Branch is deputy director of the National Center for Science Education and a CSI fellow.

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Hearts and Minds: Rebuilding Respect for Science through Engaging Science Communication

LAURA LINDENFELD

The process of science, if we manage it well, affords us a systematic way of thinking that enhances our ability to make decisions. It invites creativity and creates a sense of wonder. Yet, as Carl Sagan wrote in a 1990 issue of Skeptical Inquirer, "We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology."

Thirty-five years later, this is unfortunately still true. It's the *raison d'etre* for the Alan Alda Center for Communicating Science at Stony Brook University in New York. We help scientists around the world share their work with others through effective and engaging communication. We believe science communication is successful when approached through a willingness to be truly present and listen deeply.

People used to believe, and some unfortunately still do, that science communication should be about literacy—knowing facts and figures. If this "deficit model" thinking worked, simply understanding that we need to reduce calories and exercise to lose weight would transform our health. But people show up in the world as whole human beings with feelings, emotions, and knowledge.

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When we focus on how people feel, we enable a better exchange of knowledge and information. When we listen to hear rather than waiting for a pause to speak, we demonstrate care and empathy, the cornerstones of effective communication. This is the basis of the Alda Method: genuine connection fosters meaningful communication. The Alda Method combines two premises: improvisational theater and com-

munication strategy based on social science research. Improv teaches us to be present and listen. It's not about comedy or performance but about deepening interpersonal connections. Improv highlights the fact that communication is something we shape together. Social science helps us understand what works in communication. It guides our Alda-certified facilitators in helping scientists develop authentic, effective communication aligned with their personalities and needs. Designing effective communication means we need to understand our audiences and define clear goals for those audiences, the basis of effective communication.

We encourage scientists to build a better understanding of what their audiences care about. As they set their goals, we help them consider what they want an audience to think, feel, or do. An initial goal can be as simple as getting someone to ask a question; curiosity demonstrates willingness to learn more. Then we help them develop their strategy for reaching that goal. Last, we have them test their approach through roleplay and, eventually, real-world interactions. The experience is engaging and dynamic.

Alda Center programs are available online and in person. Through it all, our scientists work with each other, experiment with ideas and concepts together, and play in improvisational games. In addition to our foundational programs, we offer customized opportunities that focus on an organization's specific needs.

People who have experienced our workshops say things such as, "I thought I knew everything about communication, and it turns out I didn't." Or "This workshop really pushed me out of my comfort zone, but in a very positive and results driven way."

We love what we do, and it's remarkable to see how people progress in a very short amount of time. ■

Laura Lindenfeld is executive director of the Alan Alda Center for Communicating Science and dean of the School of Communication and Journalism at Stony Brook University. She holds a PhD in cultural studies from the University of California, Davis. The Alan Alda Center provides international leadership in conducting and connecting research and practice to advance clear science and medical communication. The Center has trained over 14,000 scientists worldwide and introduced over 50,000 people to the Alda Method.

For more, view Laura Lindenfeld's *Skeptical Inquirer Presents* video.

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From Believing the Conspiracies to Debunking the Funk

DAN WILSON

Information has never been more easily accessible in vast quantities than it is today. Articles, podcasts, video clips, and posts can carry this information around the world and onto screens in homes and hands extremely quickly. Unfortunately, this also applies to false stories and claims. During times of both real and perceived crises, these pieces of misinformation can offer feelings of comfort or a sense of purpose, replacing unease and confusion. I would know; I used to believe several conspiracy theories many years ago. It took me years to get out of that rabbit hole. This whole experience inspired me to start my own YouTube channel, *Debunk the Funk*, toward the end of working on my PhD thesis to debunk medical misinformation from the viewpoint of someone who once believed such messaging.

The COVID-19 pandemic created a uniquely intense period of crisis. The modern world had never seen a pandemic quite like the one caused by SARS-CoV-2, where millions of people stayed home for weeks if not months, businesses had to close, and thousands of people were dying every day. This was a scary and uncertain time. It is understandable that conspiracy theories were able to swoop in and ease these uncertainties or give people a sense of purpose and do it more easily than the more complicated and sobering truth could do. For example: "A new virus is killing lots of people? No need to fear, the government is lying about the numbers, they just want to sell a vaccine, and we can easily treat it if you buy products. Here's a promo code." The emotional impact of conspiracy theories in this context cannot be overlooked.

Dan Wilson of the *Debunk the Funk with Dr. Wilson* YouTube channel

Just a few weeks after I uploaded my first video explaining that vaccines are tested against placebos, stories of a new virus emerging from Wuhan, China, started spreading. What followed in the next few months was a deluge of mis- and disinformation. Anti-vaccine advocates who had been operating in relatively dark corners of the internet I had already been exposed to started gaining swaths of new audiences as the world seemed to turn upside down. Suddenly, long debunked ideas and conspiracy theories were gaining steam again, just repackaged into the framing of COVID-19. And these myths continue to gain steam.

Debunking and addressing these myths with data and primary sources has been the goal of my YouTube channel for the past four years. During that time, I've seen the anti-vaccine movement recycle every lie and misleading claim it has been telling for decades and slap a new "Covid" label on it. In fact, endlessly debunked false beliefs such as vaccines causing autism, 5G causing cancer, and HIV not causing AIDS have been platformed on popular podcasts and by influencers to a bigger audience than ever before. It may seem arduous and repetitive sometimes to constantly address the same false claims, but the need for it now has never been greater—and everyone can contribute, whether it is by creating content, leaving a comment, or talking to someone in your life. You might reach someone like me, who got out of the rabbit hole and went on to earn a PhD and start debunking misinformation. ■

Dan Wilson earned his PhD in biological sciences from Carnegie Mellon University. He currently works as a scientist in industry and spends some of his free time debunking vaccine and medical misinformation on YouTube with his channel, *Debunk the Funk with Dr. Wilson.*

Beyond Belief: Raising a Skeptical Kid (in the Misinformation Age)

When I decided to teach my six-year-old about skepticism and critical thinking, I had no idea how to start. Here are ten ideas that worked.

RONALD CROUCH

Several years ago, I decided to teach my first grader about skepticism and critical thinking. As a parent, I was painfully aware that I am raising a kid in the middle of what Yale philosopher Cailin O'Conner calls "the misinformation age." I knew that I should be preparing my son for it. I also believed that because I am a child psychologist I should know exactly how to do it. But the truth was that I didn't—not even a little. How does a parent BS-proof a kid? Where do I even start? It dawned on me that I had no answers. So, I did what every respectable doctorate-level professional *shouldn't* do in that situation: I Googled it.

I did not find much solid information on the topic. Out of frustration, I tried to crowd-source an answer. I posted this question on internet parenting forums: "What activities do you do with your kids to teach them critical thinking skills?" My question ended up doing the very thing that the internet seems designed to do: It led to a huge argument. But this flame war alarmed me more than usual because the parents did not argue over which activities work best or which book to follow; instead, they argued over whether to teach children critical thinking skills at all. And to my shock, many adults were against it. They had three basic arguments:

1. Children simply cannot think critically.
2. Learning critical thinking will ruin the magic of childhood.
3. Children should leave all that critical thinking stuff to their parents and "just be kids."

That did it. I went from interested in the topic to what my wife gently called *obsessed*. I knew enough about children's thinking to know the ideas behind the adults' objections could not be true. Critical thinking does not ruin the magic of childhood; *it is part of the magic of childhood*. Young children are naturals at asking the kinds of probing questions that skeptics use all the time. If you have ever been swept away in a toddler's tsunami of Socratic questions, then you know what I'm talking about. By helping kids get better at these kinds of questions, parents are joining in the very things that make childhood so magical in the first place: curiosity and wonder. The three arguments made no sense, but based on what I was seeing online, they seemed to be a dominant view. So, I finally did the thing a doctorate-level professional is supposed to

do before Googling: I looked at the research. And it was there I finally found some answers. The research handily debunked the naysayers. Here are just a few take-aways:

- The rudiments of critical thinking skills are observable even in toddlers, whose thinking process most resembles that of scientists (Gopnik 2012).
- Young children can identify when someone is a poor source of information and adjust their level of trust accordingly (Rakoczy et al. 2015).
- Little kids are more flexible in their thinking and better able to change their minds with new evidence than adults (Gopnik 2016).
- In some situations, preschoolers and kindergarteners show fewer biases in their thinking than adults (Lucas et al. 2014).
- Many kids have unrestricted access to the internet, and 74 percent report experiencing "online risks" in the past year, the most common risks being misinformation and disinformation (Gregoire 2023).

That last finding raises red flags. It means that kids are exposed to many of the same hoaxes, scams, and bad information that everyone else encounters online. It means that critical thinking should not be left to grownups. Kids need these skills just as much as adults—maybe even more.

Over the past several years, I've learned a great deal, and through trial and error with my very forgiving son, I developed activities that families can use to help their little skeptical inquirers grow their critical thinking skills. Here is a list of ten things that worked for us. They might work for you too.

1. *Start with the spooky stuff.* Kids are fascinated with ghosts, aliens, Bigfoot, and things that go bump in the night. Luckily, these are the perfect things to sharpen their skills. When a child fears what might be under the bed, look together and use the opportunity to talk about testing such ideas before believing them.

2. *Include critical thinking during play.* It is during play that children test out new ways of thinking and being, so that is the perfect time to introduce critical thinking concepts. Pretend to be a detective tracking a mythical beast. Or pretend to *be* the mythical beast! If you use critical thinking skills such as questioning, investigating, and wanting evidence while pretending during playtime, then you will soon see your child begin to use these skills outside of playtime.

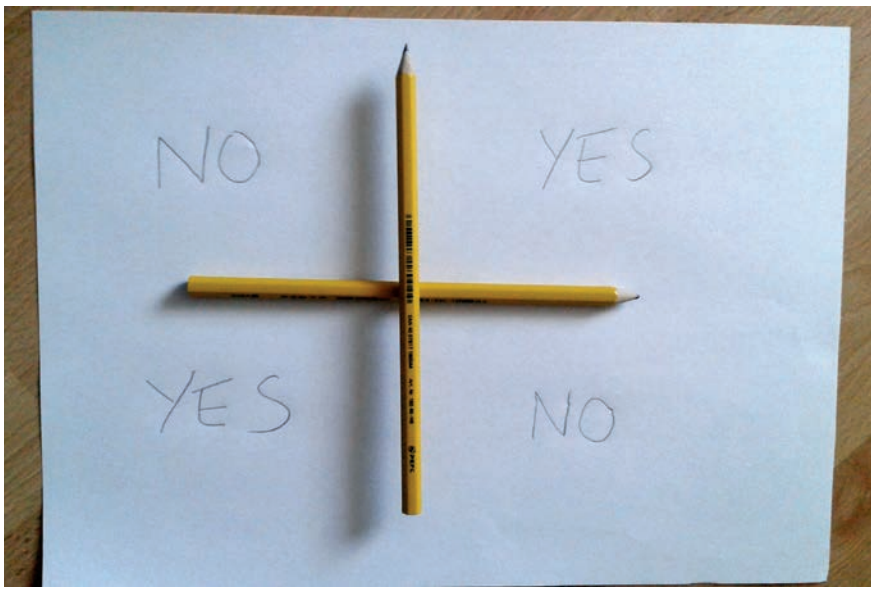
3. *Model skepticism*. It was all the way back in the 1960s when Albert Bandura first coined the term *modeling* to describe the way in which children copy the behavior of adults (Bandura 1977). When your kid sees and hears you thinking critically, they will try it out for themselves. Saying things such as "I don't know," "I don't buy it," or "I'm going to learn more about that before I decide" goes a long way to show them what critical thinking skills look like in action. And showing is far more powerful than telling.

4. *Give children the names for the critical thinking skills they naturally use.* Kids already engage in critical thinking, but they don't know it yet. Simply pointing out that they are asking Socratic questions, looking for evidence, or staying skeptical when something doesn't seem true will help them identify those skills in their own behavior. And once they identify the skills, they can use them intentionally.

5. *Praise children's use of critical thinking skills.* Once kids know the names for critical thinking skills, praise those skills by name whenever you see them. Research shows that praising a specific behavior not only increases children's sense of mastery but greatly increases the likelihood that the praised behavior will occur again (Zentall and Morris 2010). So instead of saying "great job," try "great job asking questions," "it's amazing that you wanted evidence," or "I love how you stayed skeptical."

6. *Share critical thinking heroes*. I am going to go out on a limb and guess that if you are reading this then you probably have a critical thinking hero. I'm a big James "The Amazing" Randi fan. One of the easiest ways to help kids learn why critical thinking is important to you is to introduce them to your heroes. This adds even more modeling to your overall approach. I showed my son clips of Randi testing psychics, spoon-benders, and others. He immediately grasped why I loved this white-bearded showman and became a fan too.

7. *Seize opportunities when they come up.* Every now and then something happens that is perfect for teaching skepticism. When my son was in second grade, the



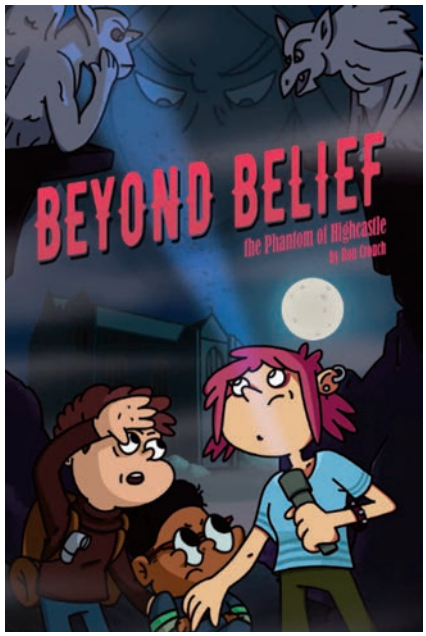
Basic setup for the two-pencil game. Source: Yunshui | Wikipedia.

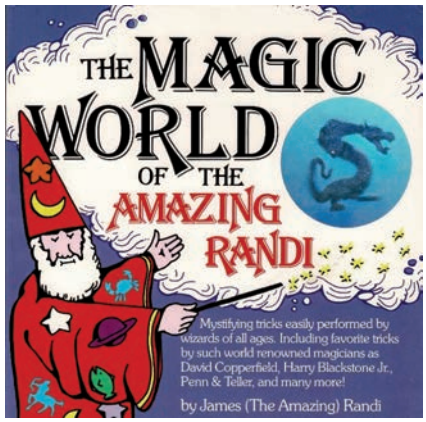
Charlie-Charlie challenge swept his school (see Polidoro 2015). We tested and debunked it at home, and I used that opportunity to teach him about dowsing. When opportunities like that come up, don't let them pass you by.

8. *(Pseudo)Science experiments.* A glance at any children's science section at the library will give you a lot of ideas for home-based science experiments. Think potato-powered clocks, baking soda and vinegar–powered explosions, and glow-in-the-dark pasta. Kids love these experiments. But science itself isn't enough to teach critical thinking skills or skepticism. You can make these at-home experiments even more focused on skepticism by creating simple tests of pseudoscientific claims. For example, my son and I made homeopathic hot sauce using nothing but water, a teaspoon of my favorite hot sauce, and a couple of mason jars. The resulting cup of water was, if homeopathic claims were correct, supposed to be even stronger than the original hot sauce, even though it probably didn't have a molecule of it left. I dared my son to drink it, which he did with a smile. You can find the video of our antics online on my website raisingaskepticalkid.com.

9. *Read books together that encourage skepticism and critical thinking.* Because I write these kinds of books for kids, I'm pretty biased about this one, but I do believe that reading together all by itself enhances critical thinking, especially if the parent and child discuss the ideas in the book. If the story happens to include skepticism and critical thinking in the content, that is even better.

10. *Take a critical thinking field trip.* If you have the opportunity to do this last one, then it is an amazing way to teach critical thinking. A critical thinking field trip is simply going to a place where a paranormal, supernatural, or pseudoscientific claim is happening and investigating it together. For example, when my son was eight, we discovered that we lived close to one of the many "gravity hills" in the United States. These are spots where it appears as though cars, marbles, and other objects roll uphill. When we found the hill, it turned out to be very slight. It was also on an open plain constantly lashed by a strong wind. We speculated that maybe the wind was pushing our car and making it look as though it were defying gravity. My son came up with the idea of opening the car doors while we rolled. He reasoned that if the wind was pushing the car up the hill, then the car would roll faster with the doors open than closed because they would act like sails. We tried it. It worked! After that, he couldn't wait to go on his next investigation. But even when we didn't solve anything, which was most times, it was always fun to grab some Scooby snacks, jump in our mystery machine, and do an investigation together. If you do this, not only could it teach your kid critical thinking skills, but it will also make lasting memories.

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by James (The Amazing) Randi

While every parent is different in the time, energy, and resources they can dedicate to the task of teaching their kids critical thinking, I've come to learn that every parent can teach the value of critical thinking and skepticism to their child. Simply modeling it, praising it, and encouraging it can make a big difference. And it is my hope that if parents begin to take on this task as a common part of parenting, then maybe we can raise a generation of critical thinkers and finally put the idea that kids can't learn critical thinking to rest once and for all. ■

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Ronald Crouch, PhD, is a psychologist, former meditation teacher, and author. He has published research in peer-reviewed academic journals, written therapy workbooks for children, and is the author of the *Beyond Belief* book series, which teaches children critical thinking skills with fun paranormal mysteries. He writes online under the name "Dr. Dad." His website is www.raisingaskepticalkid.com.

[INVESTIGATIVE FILES JOE NICKELL

Joe Nickell, PhD, has made a career in various roles solving mysteries. Studying illusory matters, he became a magician (Resident Magician at the Houdini Hall of Fame) and Hollywood stunt trainee (performing in the stunt show at the Santa Monica Main Street Fair). Licensed as a PI by the Ontario Provincial Police, he became a Pinkerton detective. Then he became an armed special officer, a homicide consultant, and recipient of a doctorate in English (with dissertation on Literary Investigation). Subsequently, he has also published numerous books, including *Crime Science* and *Detecting Forgery*.

Investigative Strategies: Creative Advance Planning That May Solve Unusual Cases

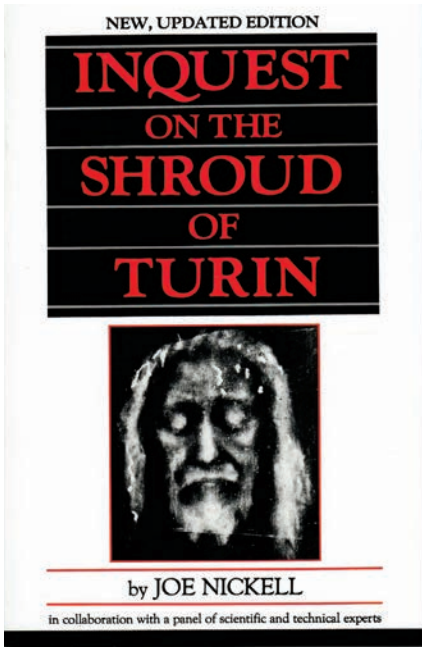
Around 1990, I coined the term *investigative strategies* to characterize some of the approaches I have found effective in attempting to solve mysteries. These strategies target particular aspects in a case to help provide a solution (examples are found in Baker and Nickell 1992, 78–88; Nickell 2012, 22–28; Nickell 2016, 3–4). I have listed here strategies I have used for some of my biggest, most successful cases.

Shroud Photo Negative

Strategy: *Conduct innovative experiments.*

The "Holy Shroud of Christ"—a so-called "perfect photographic negative image" on the Shroud of Turin—was traced back just to the fourteenth century, the time of a reported forger's confession. Believers challenged how this could be since it was long before even the concept of photography. Early on (in 1978), I discovered that the claim was false; the image on the cloth is rather a *quasi-negative* (on a photographic plate there was a quasi-positive), because it shows a figure with white hair and beard, the opposite of what would be expected for a Palestinian Jew in his thirties.

I set to work to solve the forger's method. Like others before me, I experimented with making facial images on cloth by a variety of means. These included contact prints from a human face (my improved method even lessening the wraparound distortions) and so-called vapor "photographs" (which yielded, after several attempts, only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INQUEST ON THE SHROUD OF TURIN
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in collaboration with a panel of scientific and technical experts

round blurs). I finally turned to a technique analogous to old-fashioned gravestone rubbings. To this I employed a portrait bas-relief, to which I carefully molded wet cloth and kept it in place as it dried; then I rubbed on powdered pigment, because the coloration on the shroud image was limited to the topmost fibers of the topmost threads. My work was eventually favorably eclipsed by the discovery of tempera pigments on the shroud and the results of radiocarbon dating of the cloth to 1260–1390—the time of the forger's confession. (See Nickell 1978, 30–32; 1979, 97–99, 146; 1987, 95–106; Nicolotti 2019, 372–373, 461–462.)

Geoglyph Creation

Strategy: *Employ "primitive" means to re-create phenomena.*

Called "riddles in the sand," the famous Nazca lines and giant *geoglyphs* came to special prominence in Erich von Däniken's *Chariots of the Gods?*—a book that continually underestimates the capabilities of ancient "primitive" peoples and assigns many of their works to extraterrestrials. Von Däniken envisions flying saucers hovering above and beaming down instructions to awed primitives in their native tongue. He views the large drawings as "signals" and the longer and wider of the lines as "landing strips" (Von Däniken 1970, Ch. 8). I attempted to reproduce one of the larger figures, the 440-foot-long "condor," with a crew of six using only sticks and knotted cord.

Some had suggested the Nazca might have used the grid method or plotted points by a traverse surveying technique. I knew the first could not be reconciled with the poor symmetry of some figures, and the latter was even less likely (I had experience with both methods, as a former sign painter and surveyor's chainman). My technique was to use a small drawing with a centerline and plot the coordinates of points (such as a wing tip), repeating the process on the ground. Afterward, *Scientific American* in its June 1983 issue termed the result "remarkable in its exactness" to the original (Nickell 2005, 6–17). Subsequently, I made the giant Nazca spider for *National Geographic* TV, my confidence from experience allowing me to do more work freehand (Nickell 2012, 121–125).

The author in the center of his re-creation of the giant Nazca spider geoglyph.

The author re-creating the giant Nazca spider geoglyph.

Remarkable Lookalikes

Strategy: *Seek available evidence and have experts in each discrete field determine whether or not a relationship exists.*

On May 1, 1903, a new prisoner was admitted to the federal penitentiary at Leavenworth, Kansas. At the time, identifications were made by a system of body measurements called "Bertillonage"; fingerprinting was yet to be implemented in the United States, and many police and others were dubious of it. The new prisoner was a man named Will West, but soon files showed an astonishing lookalike named William West whose measurements were so similar their differences might be due to measuring error. Had the latter escaped and then been recaptured? In short order, two men were standing together in the same room. Within a year, federal penitentiaries had gone over to the new science of fingerprinting. However, the Wests' relationship remained a mystery.

My theories on "the two Will Wests" were encouraged by FBI experts who assisted by supplying me with fingerprints, photographs, and more. I enlisted considerable independent expertise: Two experts in twins' fingerprints said the similarities of the Wests' pattern types were at a high level; an expert in ear identification said the matching indicated "identical twins"; an expert in facial features found the pair "practically indistinguishable"; and a Bertillon expert said their measurements were consistent with their being twins. A bombshell was the fact that correspondence records for the two showed that while in prison they wrote to the same brother, the same five sisters, and the same Uncle George! I published in the *Journal of Police Science* (Nickell 1980) and was invited to present my evidence to a conference of the International Association for Identification, whose members unanimously agreed with my conclusion that the Wests were monozygotic (identical) twins (Nickell 1988, 75–88).

Lost Edition

Strategy: *Keep an open mind whenever possibilities may be more plentiful than facts seem to allow.*

Ebenezer Cooke published his satire of American planters, *The Sot-Weed Factor* (i.e., a tobacco merchant), in London in 1708. After he moved to America, he published a third edition of that book, and in between he also penned a sequel, *Sotweed Redivivus*. However, he referenced a "second edition," which was implied by the existence of the "third"—yet not a single copy of the second ever came to light.

My professor, distinguished scholar John T. Shawcross, unlike some who would permit their students to do only *critical* papers, was aware of my detective background and allowed—even encouraged—my writing *investigative* papers. One day after class, I brought up the enigma of the lost Cooke edition. "Yes?" he responded, showing real interest. "I think I've found it," I said, and his eyes

Portrait illustration of Ambrose Bierce.

danced. I had begun, I told him, by realizing that the word *edition* had a looser meaning in Cooke's time than ours. I suspected that the "sequel," *Sotweed Redivivus*, actually *was* our missing second edition. After all, it was Cooke's second *Sotweed* book, and the adjective *redivivus* ("revived") could be interpreted as "reissued." An analysis of the text belied the idea that it was a sequel and revealed that it was much more like a revised (Americanized) work. Comparing words and phrases in available drafts of the preface for a second edition with those used in the actual preface of *Sotweed Redivivus* clearly proved my case: It had been in plain view for some two and half centuries! (See Nickell 2005, 106–117.)

Bierce Disappearance

Strategy: *In the case of a missing person, instead of focusing only on the end of that person's life, consider the major troves of evidence left throughout their life.*

American writer Ambrose Bierce (1842–1914?) managed to convince many that he had disappeared during the Mexican Revolution. Yet the U.S. government was unable to confirm that Bierce had crossed the border into Mexico. Why had he shown a friend a picture of the canyon of the Colorado and promised "nobody will find my bones?"

Here is some of the evidence that Bierce committed suicide:

- Bierce was fascinated with "Mysterious Disappearances," as he titled a trilogy of supernatural tales in his book *Can Such Things Be?* (published in 1893).
- He had written a powerful essay advocating suicide titled "Taking Oneself Off." In it he insisted, "Suicide is always courageous." (So much for those, including some who knew him, who insisted Bierce was "not the type" who would commit suicide!)
- As early as 1910, Bierce had written of the Grand Canyon: "I'd like to lay my bones there about." He told his friend Walter Neale that he had a German revolver for the purpose.
- He had written farewell letters to friends, saying to one, "My work is finished, and so am I." To another, he said he longed for "the good, good darkness." And to still another he stated, "I am going away and have no notion when I shall return."
- Bierce had put his affairs in order—closing out everything, permanently.
- Then there is the revealing letter he sent his daughter in early 1913, giving up his cemetery plot. It ends with the statement that he did "not wish to lie there. That matter is all arranged and you will not be bothered by the mortal part of [signed] Your Daddy" (Nickell 2021, 14–16).

As to Bierce's bones, no one has ever found them.

***

As these five important historical cases demonstrate, investigative strategies can pay dividends in proportion to the time spent brainstorming them into existence. Even relatively minor cases can profit from time spent on them. ■

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[NOTES ON A STRANGE WORLD

MASSIMO POLIDORO

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Conspiracy Theories: A Call to Adventure

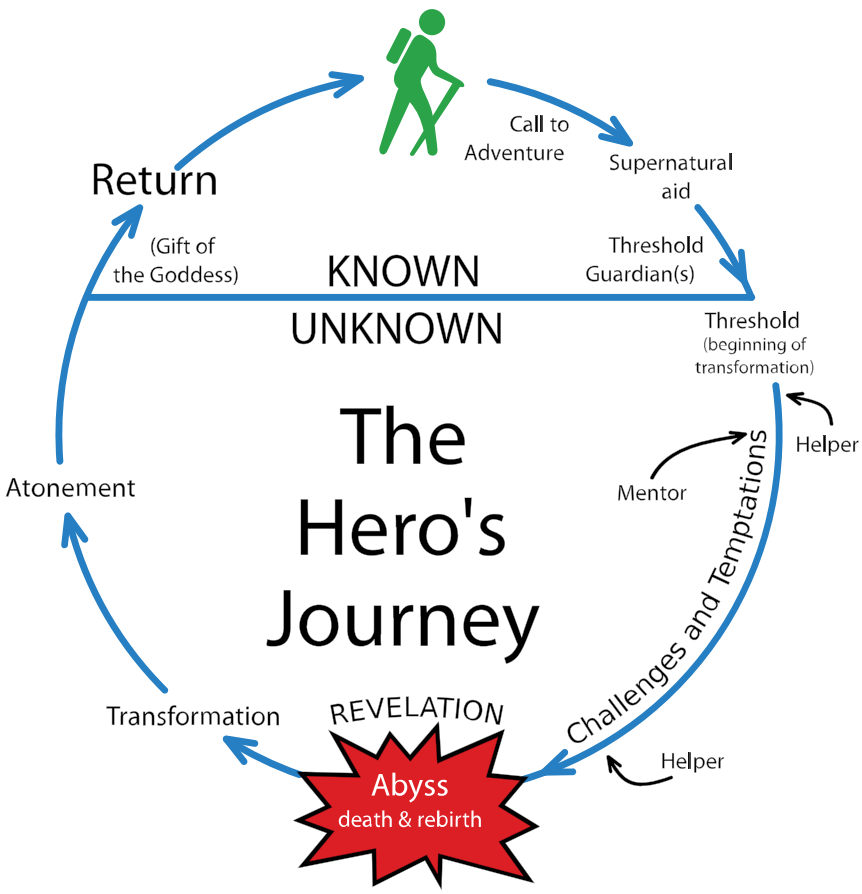
Conspiracy theories are undoubtedly among the most effective and engaging stories capable of provoking intense emotions. From the idea that the Earth is flat to the belief the Moon landing was staged on a film set—not to mention theories surrounding the assassination of President John F. Kennedy and the attacks on September 11, 2001—conspiratorial narratives have a powerful appeal.

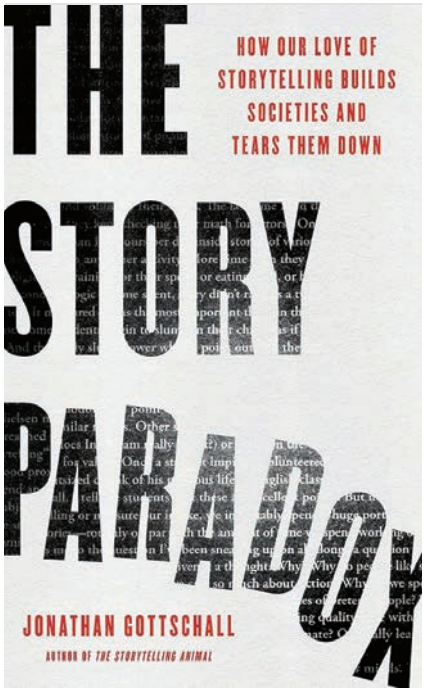
There are various psychological reasons conspiracy theories resonate with so many people, as we've often explored in Skeptical Inquirer, including in this column. There's the proportionality bias, for example, where we struggle to accept the idea that colorless characters, almost squalid in their mediocrity, are behind sensational events such as the assassination of a president or a terrorist attack against the world's most powerful nation. We imagine there must *necessarily* be something bigger, some sinister grand scheme. There's the notion that conspiracy theories seem to restore order—albeit entirely artificially—to a chaotic and unpredictable reality that scares us and creates anxiety. There's the need to protect our self-esteem by always seeking an external culprit for anything that goes wrong for us or our tribe. There's all this and much more, but above all, there's the fact that conspiracy theories are compelling stories.

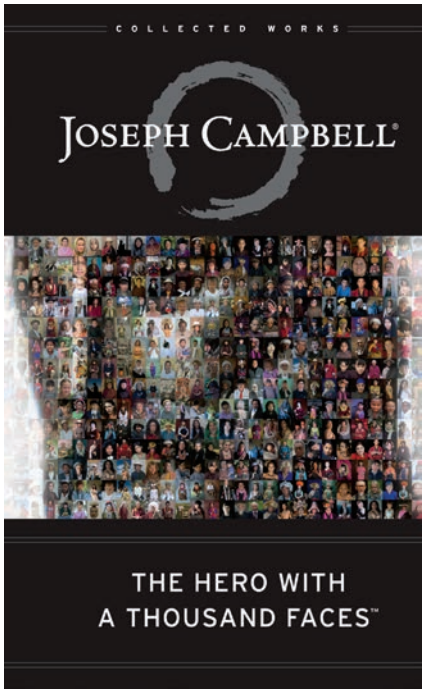
They are highly captivating thrillers that stand in contrast to the non-stories of those who have the thankless task of debunking conspiracy hoaxes. On one side, there are tales that could easily be turned into Hollywood blockbusters; on the other, there are people who meticulously explain how there are no aliens in Area 51, how the CIA or FBI didn't in fact kill Kennedy, how a global gathering of elderly Jewish men plotting a world conspiracy never existed, and how the Earth is not actually flat. There's no contest as to which is more engaging!

This is why, on the internet, false news travels farther, faster, deeper, and more broadly than true news. To understand how this happens, researchers at MIT used data related to the spread of rumors and gossip on Twitter from 2006 to 2017 (Vosoughi et al. 2018). About 126,000 rumors were spread by roughly three million people. The researchers found that false news reached about six times as many people compared to true news. Most importantly, they also discovered—debunking many clichés—that social media algorithms accelerated the spread of both true and false news at the same rate. This means that false news manages to spread more than the truth for a very simple reason: it's humans, not robots, who choose to propagate it.

This is further evidence that the




THE STORY PARADOX
HOW OUR LOVE OF STORYTELLING BUILDS SOCIETIES AND TEARS THEM DOWN
JONATHAN GOTTSCHALL
AUTHOR OF THE STORYTELLING ANIMAL



idea of a "free marketplace of ideas"—the belief that in a confrontation between false and true ideas, the latter will always eventually prevail in any discussion—imagined by John Stuart Mill in 1859 is entirely unfounded. If conveyed through a good story capable of evoking emotions, false ideas and news will always win, six to one.

If the genuine feat of the Moon landing can at most evoke a sense of admiration, the conspiracy story denying the Moon landing is much more engaging. It requires action to combat evil. Conspiracy stories are tales of moral horror. And they are mostly written in the present tense. As Jonathan Gottschall observes in *The Story Paradox*, even if conspiracies about the Moon landing or Kennedy assassination refer to long ago, the dark forces that supposedly orchestrated them are still committing every possible misdeed today. All conspiracy narratives urge their followers to do something about it as if it were a matter of the highest moral duty (Gottschall 2021).

Joseph Campbell, historian of religions and pioneer of comparative mythology, understood very well the importance of stories from this perspective. "When the story inhabits your mind, you understand how important it is for your life: it offers you the perspective through which to look at what is happening to you," he says in *The Power of Myth*, a book-conversation with journalist Bill Moyers (Campbell and Moyers 1988). Campbell is famous, above all, for having formulated the different stages of the Hero's Journey that is present in all great stories—from Greek myths to British legends, from folklore to modern cinema and novels. In *The Hero with a Thousand Faces*, Campbell argues that any myth or legend centered on a hero—from Odysseus to Perseus, from David to Osiris, up to Frodo Baggins and Harry Potter—is based on an archetype that leads every tale to share the same structure (Campbell 1949). It's a cycle that goes from the "call to adventure" to crossing the first threshold, from leaving the ordinary world to approaching the cave, then the central ordeal, the reward, the return, and finally the rebirth. It's the schema found in *Star Wars* as well as in *Robin Hood*, in *King Arthur* as well as in *Indiana Jones*, in *The Seven Samurai*, *The Silence of the Lambs*, *The Fugitive*, *E.T.*, and *The Godfather* (Voytilla 1999). But it's also the same schema found in conspiracy stories. By inducing many to think that people are nothing more than flocks of sheep manipulated by evil hidden puppeteers, a true call to adventure is activated. One must abandon hesitations and embark on a long journey, hindered by derision, slander, and mockery from skeptics and debunkers, which will lead the most skilled to uncover clues capable of exposing the puppeteers. One day, their genius and courage will be recognized by all, and they will see themselves immortalized in history books as the heroes who answered the call to adventure and saved the world.

Only from this perspective can we understand the enormous gratifying power that conspiracy stories offer to those who decide to venture down the rabbit hole—that is, that deep well similar to where Alice fell, but where, at the bottom, there's no Wonderland. Instead, it's a place where conspiratorial obsessions end up draining the time, energy, and often the resources, dignity, and not infrequently the mental health of those who get caught up. This explains why it is so difficult to help those unfortunate enough to fall in: as long as you remain immersed in the conspiratorial narrative, you see yourself as a hero of thought. But admitting you were wrong means recognizing that all along you've been in a different story. It wasn't an epic saga where you and your friends fought monsters but a tragicomedy where you were merely tilting at windmills. ■

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[THE PHILOSOPHER'S CORNER MASSIMO PIGLIUCCI

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It's All Bullshit: The Common Ground between Pseudoscience and Pseudophilosophy

Editor's note: A few months ago, Massimo Pigliucci shared with the editorial team that he'd soon be wrapping up this column so that he could spend the extra time working on other pursuits. This will serve as his final column. We're sad to see the column end, but we're also so thankful that he's a member of SI's 100 Club—if you search his name at skepticalinquirer.org, he's one of the few people who has over 100 contributions. He was first published in SI in 1999, and from 2003–2015 he wrote a regular column called "Thinking about Science." During that first run, his influential book Nonsense on Stilts *was published, and I was lucky enough to hear him speak about it at a Skeptics in the Pub event held by the Skeptical Society of St. Louis. He returned with his new column, "The Philosopher's Corner," in 2022, and I've felt quite lucky to have his insights included in these pages during my time as editor. Fortunately, Massimo has promised to continue sending us occasional articles in place of the regular column, and he already has a piece in the works. Thank you, Massimo, for all you've done for SI, our readers, and skepticism!*

Believe it or not, *bullshit* is now a technical term in philosophy. It was treated as such in a modern classic, Harry Frankfurt's best-selling *On Bullshit*, in which the author affirms that "One of the most salient features of our culture is that there is so much bullshit" (Frankfurt 2005, 117). I hear ya, brother.

Frankfurt helpfully distinguishes the common liar from the bullshitter:

> It is impossible for someone to lie unless he thinks he knows the truth. … A person who lies is thereby responding to the truth, and he is to that extent respectful of it. When an honest man speaks, he says only what he believes to be true; and for the liar, it is correspondingly indispensable that he consider his statements to be false. For the bullshitter, however, all these bets are off: he is neither on the side of the true nor on the side of the false. His eye is not on the facts at all, as the eyes of the honest man and of the liar are. … He does not care whether the things he says describe reality correctly. (Frankfurt 2005, 130–131)

This notion of bullshit immediately lends an explanation to a principle that should be well known to skeptics: Brandolini's Law, named after the Italian programmer Alberto Brandolini, who in 2013 tweeted, "Bullshit Asymmetry Principle: the amount of energy needed to refute bullshit is an order of magnitude bigger than to produce it"—which accounts for why being a skeptic is an extremely frustrating experience. Brandolini himself said that he was inspired by reading psychologist Daniel Kahneman's *Thinking, Fast and Slow* right before watching a debate between former Italian Prime Minister Silvio Berlusconi and journalist Marco Travaglio. With 2024 being an election year in the United States and in many other parts of the world, I'm sure we can all relate.

Apparently, the concept is much older, as it was expressed at least in the

Art by Howard McWilliam for the cover of *Skeptical Inquirer* Vol 47 No. 5, exploring "persuasive bullshitters"

middle of the nineteenth century by the French economist Frédéric Bastiat, who said: "We must confess that our adversaries have a marked advantage over us in the discussion. In very few words they can announce a half-truth; and in order to demonstrate that it is incomplete, we are obliged to have recourse to long and dry dissertations" (Bastiat [1845] 1873). As is often the case, not much new under the sun.

Quite obviously, the concept of bullshit applies to a lot of what is of concern to modern skeptics. I'm sure many readers will remember Penn & Teller's television show by the same title. A prime example of Brandolini's Law is the claim that vaccines cause autism, infamously put forth by disgraced British doctor Andrew Wakefield in a paper that was eventually shown to be fraudulent and that contributed to countless deaths and sickness.

Bullshit *a la* Frankfurt has two important characteristics: (i) It is a normative concept, meaning that it is not just a description of things but rather is concerned with how one ought to behave or not to behave; (ii) The specific type of culpability that can be attributed to the bullshitter is *epistemic* culpability, that is, a failure to do one's due diligence when it comes to knowledge claims.

Such failure can arguably be considered a moral failure. This is the position of the ancient Roman philosopher Marcus Tullius Cicero, who wrote in his *De Divinatione*: "To hasten to give assent to something erroneous is shameful in all things" (I.7). In that book, as I have explained in a previous column (Pigliucci 2024), Cicero mounted the first known concerted attack against pseudoscience, specifically divination and astrology. Much later, the mathematician William Clifford published a landmark essay in *The Contemporary Review* in which he argued that "It is wrong always, everywhere, and for anyone to believe anything on insufficient evidence" (Clifford [1877] 1999). That is why the work of a skeptic is so important: it has a practical and moral dimension.

More recently, my colleague Victor Moberger of Umeå University in Sweden has expanded the application of Frankfurt's conception of bullshit to yet another "pseudo" activity: *pseudophilosophy*. Just like there is good science and fake (the literal meaning of *pseudo*) science, so, naturally, good philosophy has its own fake counterpart. (Yes, I realize that some readers of SI don't think there is such a thing as good philosophy, but hopefully this very column has changed a few minds over the years!)

According to Moberger, there are in fact two broad categories of pseudophilosophy. First, we have what he labels the obscurantist variety, "a seemingly profound type of academic discourse that is pursued primarily within the humanities and social sciences." Then there is scientistic pseudophilosophy, "usually found in popular scientific contexts, where writers, typically with a background in the natural sciences, tend to wander into philosophical territory without realizing it, and again without awareness of relevant distinctions and arguments" (Moberger 2020, 7). Let's take a closer look.

Here is a famous example of obscurantist pseudophilosophy:

> [Einstein had an] obsession with transporting information through transformations without deformation; his passion for the precise superimposition of readings; his panic at the idea that observers sent away might betray, might retain privileges, and send reports that could not be used to expand our knowledge; his desire to discipline the delegated observers and to turn them into dependent pieces of apparatus that do nothing but watch the coincidence of hands and notches. (Latour 1987)

These nonsensical words were written by postmodernist philosopher Bruno Latour, one of the protagonists of the infamous "science wars" of the 1990s (Sokal and Bricmont 1997). It betrays a fundamental misunderstanding of Einstein's theory of relativity, based—by Latour's own admission—on an essay written by Einstein for the general public, not on the careful study of actual technical papers concerning the theory. Bad scholarship leads to philosophical bullshit.

You may like the following example a bit less, though: "Traditionally these are questions for philosophy, but philosophy is dead. Philosophy has not kept up with modern developments in science, particularly physics. Scientists have become the bearers of the torch of discovery in our quest for knowledge" (Hawking and Mlodinow 2010). It's a taste of what Moberger calls scientistic pseudophilosophy, penned by none other than Stephen Hawking, who knew nothing about philosophy or the history of science and who proceeded—in the rest of the very same book—to write a decent, if a bit amateurish, essay on … the *philosophy* of science.

The bottom line, my friends, is that pseudoscience is bullshit with scientific pretensions, while pseudophilosophy is bullshit with philosophical pretensions. And what pseudoscience and pseudophilosophy have in common is bullshit. It is incumbent on skeptics to fight bullshit, in whatever form and shape. That's the whole point of what we do. Sometimes this may even mean having the courage to criticize our own friends or people who are usually on our side of the barricade. As Aristotle, concerning a similar situation, famously put it: "Humility requires us to honor truth above our friends" (Aristotle n.d.). Of course, the phrase was a double *entendre*, because the friend he was referring to was his former mentor, Plato. ■

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[BEHAVIOR & BELIEF STUART VYSE

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Spiritualist History in London (and Cambridge): A Skeptic's Tour

I appear not to be like other tourists. Because I am interested in science and pseudoscience and because I am a writer who—like most of our ilk—is perpetually on the prowl for material, when I visit a new city, I find myself seeking out the science, magic, and superstition unique to that place. So far, this has produced "A Skeptic's Tour of Paris" parts one (Vyse 2021) and two (Vyse 2024), but this year I went to London—and briefly Cambridge—England.

Nerd Alert!

The following is not for everyone, but if you are as interested in the history of Spiritualism as me, London will not disappoint. At 16 Queensberry Place in the South Kensington neighborhood of London, you will find the College of Psychic Studies. Now why would a skeptic be interested in an institution based on the idea that "consciousness beyond matter" is possible and is a frequent host to mediums who lecture, teach courses, and give readings? The answer has to do with the nineteenth-century beginnings of the Spiritualism movement.

Nineteenth-century Spiritualism was bound up with the reform movements of that time: women's suffrage, temperance, child labor reforms, and abolitionism. Psychic mediums were overwhelmingly women who were

Author's photo.

A scrying mirror used by the famous Scottish medium Helen Duncan (author's photo)

Shewing the Influence of Osiris (1895) by Alice Essington Nelson (author's photo)

able to achieve some prominence—and, on occasion, income—by holding séances in their homes, and one of the interesting outgrowths of the Spiritualism movement was abstract art. As I described in a previous column (Vyse 2022b), several women Spiritualists are now recognized to have been important early innovators in the emerging field of abstract art, and the College of Psychic Studies has extensive holdings in Spiritualist art as well as spirit photography.

For a fee, the college will arrange group guided tours of their archives, but because I was a solo traveler, that option was not available to me. Nonetheless, I contacted the college's archivist, Jacqui McIntosh, who informed me that each of the college's many meeting rooms have permanent displays of Spiritualist art and related items, and because there was an ongoing art show during the time of my trip, I could view those displays during business hours any weekday. She kindly shared her schedule with me so I could arrange to visit when she would be there.

The College of Psychic Studies did not disappoint. Their display cases hold an extensive collection of Victorian psychic paraphernalia, including spirit trumpets used to "concentrate psychic power," planchettes used in séances, scrying mirrors used in divination, and slates used by mediums for automatic writing. The scrying mirror shown here belonged to the famous Scottish trance medium Helen Duncan, who was studied by psychic investigator Harry Price and found to be a fraud. Duncan specialized in producing ectoplasm from her mouth, which Price determined was made from cheese cloth and egg whites that Duncan swallowed in advance and regurgitated during séances (Price 1933). Duncan was ultimately convicted of fraud and jailed by a Scottish court under the Witchcraft Act of 1735, which made it a crime to falsely claim to have summoned spirits. The Witchcraft Act was subsequently repealed.

An 1872 photograph of Mary Todd Lincoln taken by William H. Mumler appearing to show the ghost of Abraham Lincoln. This image was taken from Wikipedia, but the College of Psychic Studies had a copy of this photo and several others by Mumler.

Although I was not able to view the college's very valuable collection of artwork by Georgiana Houghton, there was a remarkable amount of Spiritualist art on display, both contemporary and Victorian. As a skeptic, my interest is in the history of Spiritualism, and as a result, I was primarily interested in the older pieces in the college's collection. In particular, the college owns a very large number of spirit photographs, including several by famous American photographer William H. Mumler (1832–1884), whose clients included Mary Todd Lincoln. Mrs. Lincoln was a spiritualist, and Mumler produced photos of her that appeared to show the ghostly figure of her dead husband hovering over her. Like all spirit photographs, Mumler's were fabrications, but they were widely distributed. The college has a very large collection of fascinating spirit photos by Mumler and several other photog-

raphers.

There are far too many interesting pieces in the college's collection to display here, but I will leave this section with a painting thought to be the only surviving work of British spiritualist Alice Essington Nelson (1846–1921). The work is called *Shewing the Influence of Osiris* and is described as "a mental horoscope" produced automatically on November 26, 1895.

The Society for Psychical Research

In the nineteenth century, there were several Spiritualist and psychic groups in England, often with overlapping memberships. According to an account by Donald West (2015), the Society for Psychical Research (SPR) grew out of a suggestion made by a member of the Ghost Society of Cambridge, Henry Sidgwick, who was a fellow of Trinity College, Cambridge, and a lecturer in moral philosophy. Sidgwick went on to become the society's first president in 1882. The purpose of the society was "to approach these various problems [in] the same spirit of exact and unimpassioned inquiry as has enabled science to solve so many problems, once not less obscure nor less debated" (West 2015). The SPR describes itself as the first organization established to scientifically research claims of psychic phenomena. American psychologist William James was an early member who went on to found the American Society for Psychical Research (Knapp 2017).

The various Victorian-era psychic groups were often in conflict. The London Spiritualist Alliance, which later became the College of Psychic Studies, frequently had disputes with the Society for Psychical Research, because they supported a medium that the SPR had labeled a fraud, or vice versa. Sir Arthur Conan Doyle, author of the Sherlock Holmes books and a longtime spiritualist believer, joined the SPR in 1893 and also served as president of the College of Psychic Studies when it moved to its present location in the townhouse at 16 Queensberry Place in 1925. But in 1930, Conan Doyle had a dispute with the SPR and resigned his membership, claiming that the investigative methods used were biased: "assertions of the opponents of Spiritualism are at once accepted on their face value without the slightest attempt at discriminate examination" (Savage 2019). As a measure of Conan Doyle's influence in the field, his resignation was followed by those of many others. But the SPR remains an active organization with a regular calendar of meetings and events. As this dispute with Conan Doyle suggests, of the two institutions—the College of Psychic Studies and the Society for Psychical Research—the SPR is more skeptical in its approach. There are true believers in both organizations, but there are also some skeptics in the SPR. For example, CSI Fellow Prof. Chris French is a member of SPR, and now, so am I.

Knowing a little about the history of the society, I was interested in visiting the SPR's offices and their library, which are in West London not far from where I was staying. The library was open to non-members on a very limited basis, so I chose to pay the fee and become a member, which was easy to accomplish. Once I was onboard, Peter Johnson, the SPR secretary, graciously arranged a time for my visit and spent an hour showing me around and answering questions. The SPR publishes both a journal and a magazine, sponsors lectures, and maintains the *Psi Encyclopedia* (https://psi-encyclopedia.spr.ac.uk/). The library has an extensive collection of books and journals related to the paranormal, mediumship, and occult experiences, and the walls are covered with photos of past presidents of the organization and other figures from the history of psychic research. But my most interesting SPR research took place in Cambridge.

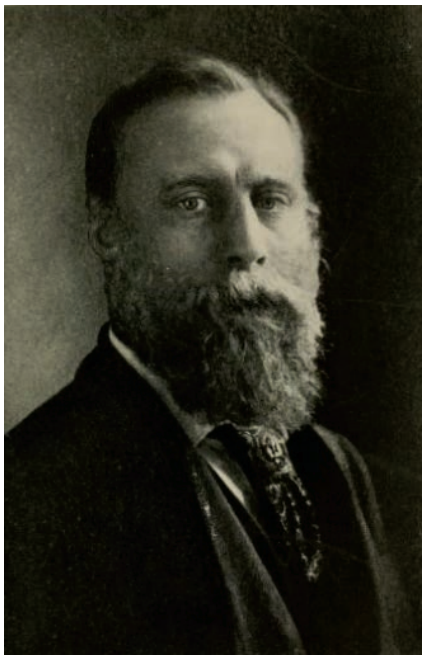
A portrait of the famous trance medium Leonora Piper (1857–1950) among the holdings of the College of Psychic Studies (author's photo)

A Cambridge Side Trip

Cambridge, England, is a lovely town an hour's train ride north of London that is home to Cambridge University, and on my recent trip, I spent one night there. This happened to be a fortunate coincidence, because long after I planned the trip, I learned that the archives of the Society for Psychical Research are held in the special collections department of the university library. Now that I was a member of the SPR, I was able to get a letter of introduction that allowed me to visit the special collections department and look through some very historic items.

I have a particular interest in the Boston medium Leonora Piper, who was such a success that she managed to convince many skeptics of her abilities. Piper was extensively studied by the American Society for Psychical Research and made several trips to England to be tested by members of the SPR, and psychologist William James had several sittings with her, as did the pioneering American architect Theodate Riddle Pope, whom I wrote about in a previous online column (Vyse 2022a).

Having obtained my letter of introduction, I contacted the special collections department at the Cambridge University Library and searched the online listings for items I wanted to see. Because a librarian had to fetch the items I wanted to work with, I was told to make requests a day or two in advance. As is typical of special collections research, when I arrived, I had to put my belongings in a locker and was only allowed to bring pencil, paper, and my iPhone into the reading



Richard Hodgson (1855–1905), psychical researcher and associate of William James who worked extensively with Leonora Piper (Wikipedia)

room. Several folders of varying thickness were waiting for me, and I spent a very pleasant couple of hours leafing through them. The most interesting things I found were:

1. A letter sent by Theodate Pope containing Piper's first attempts to channel Richard Hodgson and reproduce his signature. Hodgson was an employee of the American Society for Psychical Research who had worked with Piper for many years. He had previously exposed other psychics as frauds, including the Italian medium Eusapia Palladino and the Russian mystic and founder of Theosophy, Helena Blavatsky, but he was convinced that Leonora Piper's "spirit controls" were actually spirits of the dead (Tymn 2015b).

When Hodgson died suddenly of a heart attack, Piper claimed to be controlled by his spirit during some of her trances, and she attempted to write his signature. Theodate Pope's note described this as, "Hodgson's first attempts to write his name." The marks all looked like illegible scribbles to me.

2. A postcard from William James to Richard Hodgson written while James was traveling in Germany. This might not seem like much, but for a student of psychology, holding in your hand something William James wrote is a big deal.

3. A letter dated May 26, 1909, from Alta Piper, Leonora's daughter, to Oliver Lodge of the SPR, reporting on the psychologist G. Stanley Hall's sittings with her mother. G. Stanley Hall was a psychologist and president of Clark University, and he convinced James to let him and his associate, Amy Tanner, participate in sittings with Piper. Hall and Tanner approached Piper's mediumship with much greater skepticism than James and Hodgson. In the letter, Alta reported that, during a sitting with an unrelated individual, "Hodgson broke in with a message which he asked me to send to you at once." The message, in part, was "Tell Lodge that Hall is not the type of investigator that we desire. His attitude towards the whole thing is very bad and material, and his tricks do not meet with my approval." Among other things, Hall and Tanner were able to get Piper to describe a niece, Bessie Beals, who never existed (Tymn 2015a).

Hall and Tanner would go on to conclude that there was nothing paranormal in Piper's séances but that she was quite skilled in assuming different personalities. Tanner outlined their findings in her 1910 book *Studies in Spiritism*.

***

Victorian-era Spiritualism is not everyone's cup of tea, but if you are interested in the history of mediumship and early séances, London and Cambridge have a wealth of material on display. In addition, you can get a decent cup of tea.■

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[THE PRACTICAL SKEPTIC MICK WEST

Mick West is a writer, investigator, and debunker who enjoys looking into the evidence behind conspiracy theories and strange phenomena and then explaining what is actually going on. He runs the Metabunk forum and is the author of the book *Escaping the Rabbit Hole*.

Quick Guide to Modern Video Analysis Techniques for UAP (and UFOs)

The analysis of UAP (unidentified anomalous phenomena) has become an increasingly mainstream activity. Years of lobbying by people concerned that UAP represent a nonhuman threat have resulted in legislation directing the Pentagon to study the topic.

UAP were once called UFOs (unidentified flying objects), and most of the public still prefers that term. *UAP* was deliberately adopted in the 2020s to avoid the stigma around *UFOs* that has built up over the past few decades.

The purpose of investigating UAP is twofold. First, we want to identify the object. If we can prove that a light in the sky was a particular plane, for example, then UAP is no longer an issue. Second, and more important, we want to *detect anomalies*. While *UAP* has *anomalous* in the name, for something to be classified as a UAP, it simply needs to be unidentified. Unfortunately, the name change introduced this ambiguity, and *UFO* would be more descriptive.

UAP analysis attempts to demonstrate if a particular event was unambiguously anomalous—meaning it has no plausible natural or known human causes. It must pass the first test of not actually being identified but must also demonstrate, unambiguously, that it does something like: move impossibly fast, accelerate with impossible power, teleport, or defy gravity with no detectable means of lift.

It's now a significant effort. Millions of dollars are spent on the All-domain Anomaly Resolution Office (AARO), the Pentagon's new UAP investigation team. AARO works with other teams in the intelligence and scientific communities to analyze these cases. While the stigma of UFOs remains, there are genuine national security reasons for UAP analysis.

Over the past decade, I have analyzed hundreds of UAP/UFO cases, often in collaboration with other interested people on my forum, Metabunk. During that time, we have developed informal best practices and a set of resources and software tools that have led to considerable success in identifying unidentified objects. While we have yet to find anything unambiguously anomalous, the reduction in noise from eliminating the identifiable should help surface such things, if they exist.

In recent years, increases in computing power, the easy availability of public datasets, modern image processing tools, and the increasing ease of coding solutions with open-source software and AI have brought us to a new era of UAP investigations, particularly when it comes to UAP videos. Here, I will give a brief overview of some of the key techniques we use that have proven useful in resolving cases.

Fundamentals

The fundamental task of video analysis is to convert the sequence of two-dimensional images in a video into a useful representation of the real world.

The first step here is to get the original video. This is overlooked surprisingly often, with analysis sometime being performed on degraded copies that have either been downloaded from social media or have been shared as smaller files over email. Not only does this reduce the video image quality, it also sometimes removes individual frames, or adds new ones. We often do frame-by-frame analysis, so we want all the original frames.

Using a secondary copy also means you will be dealing with missing or corrupt metadata. Often called "Exif" (Exchangeable image file format), this is extra data that can be incredibly useful in analysis. In particular, videos often have a precise GPS location and a timestamp. When the video is shared, this data is often removed; location is stripped for privacy reasons, and the timestamp is sometimes changed to the time the video was shared or when it was last edited in any way.

Enhance (or Don't)

Once you have the original video, you can create enhanced copies that can aid with analysis. The most powerful enhancement is usually stabilization. Videos are often taken by hand and sometimes from a moving vehicle. Stabilizing it can help determine what is real motion and what is simply the camera moving.

I use Adobe After Effects for stabilizing, but there are several other tools. I will usually use *feature tracking*, meaning I track one point in the video, usually something in the background, and then stabilize it so that point does not move.

Automated tracking might not work, as UAP videos are nearly always very poor quality—if they were better quality, you'd be able to see what the

UAP was, and therefore it wouldn't be a UAP. You might be forced to do some of the tracking manually. This can be a tedious task but spending half an hour manually frame-advancing and moving the tracking point can ultimately save you a lot of uncertainty later.

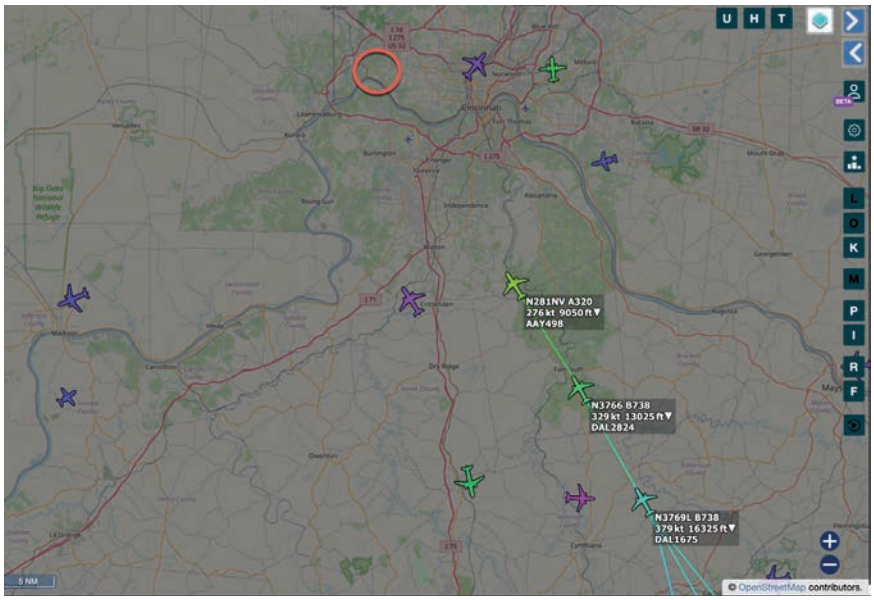
Feature tracking can also be used to extract information from a video. If you have an artificial horizon, then you can track the ends and record how the horizon angle changes over time.

The video image itself might also be enhanced to bring out more detail. But here we come to one of the more annoying issues of modern video analysis: destructive enhancement. When you do simple enhancements such as adjusting the brightness, so long as you don't go too far, you will not destroy a significant amount of information. But more extreme adjustments to the brightness and contrast can look like they improve some areas, but they might blow out others. Avoid old-fashioned adjustments such as brightness and contrast, which essentially push everything in the same direction. Instead used the more modern Highlights and Shadows functions, which expand and contract certain ranges of brightnesses without affecting others. For finer, albeit fiddly, control, I often use the Curves tool.

Where you need to use a lot of caution is in using filters that actually change the pixels. These are things such as sharpening, edge detection, embossing, and upscaling. These can be useful for detecting the position of small moving objects, but they are generally *not* helpful in determining what those objects are.

Embossing, and similar filters, will add pixels and create the illusion of an object lit from a particular direction. Upscaling (increasing the resolution of an image) will also add pixels, and with the advent of AI upscaling, it can invent actual details that simply don't exist in the original. Researchers unfamiliar with these problems have progressively "enhanced" video until they could make out extraterrestrial beings or the shape of non-human craft.

Eliminating Aircraft



Three planes line up with the camera location, making them likely candidates.

One of the more common sources of UAP sightings is aircraft. In decades past, UFO researchers would have to call the local airports, or even travel agents, to try to determine what planes might have been seen. Now plane schedules are all online, and beyond that, we can now replay the flight activity over a certain area to see what planes might have been visible.

This is possible because thousands of volunteers run tiny radio receivers that download the position data of nearby planes (using a system called ADS-B) and send that data to a variety of organizations, such as ADBS Exchange, which then store the data. This allows you to look up the current positions of nearby planes, or historical positions of planes, anywhere in the world, going back three years or more.

This is something I do several times a week, and is a relatively straightforward process:

1. Find the time and location of the event. Convert the time to UTC format (essentially GMT).
2. Go to https://globe.adsbexchange.com/?replay, move the map over that location, and set the date and time.
3. Find candidate planes. Basically, anything in the right direction from ten to 100 miles away.
4. Click on the plane, then, in the left pane that pops up, export the KML file. (Use "geometric altitude.")
5. Open the KML file in the Google Earth Pro app (a free download from Google).
6. Position the camera in Google Earth where the camera was, and look toward the plane. If it matches what the video shows, then that's the UFO!

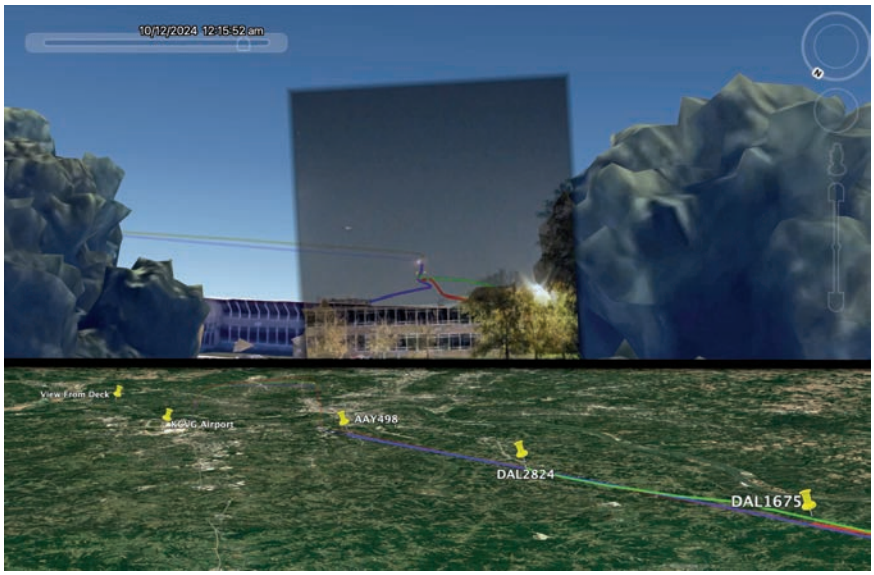
In a recent example, a spotter near Cincinnati saw what looked like a triangle of three lights hovering over a building at 00:14 UTC on October 12. I suspected this was three planes heading toward the camera. So, I ran through the process above, and sure enough there were three planes in a row heading straight for the camera location.

Downloading the KML files and then dropping them into Google Earth Pro showed that those three planes would appear in the exact same spot as the triangle of lights.

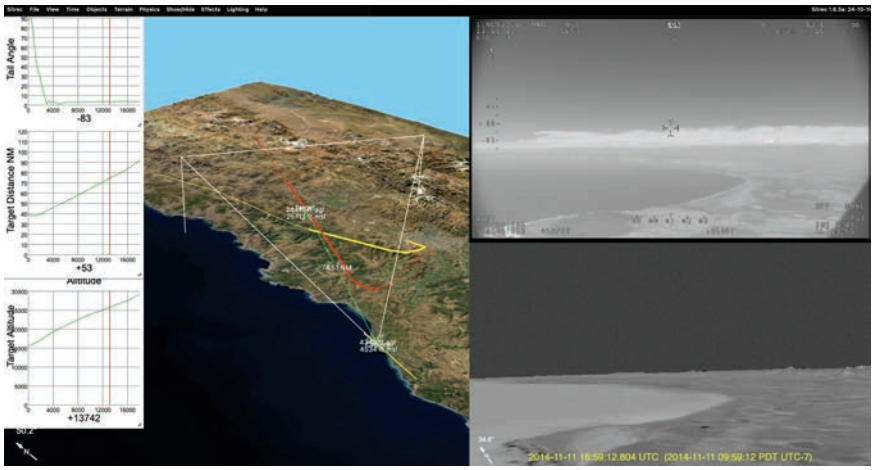
Public Data

ADB-S flight position data is one example of a publicly available database that can be used to examine historical events. There are many others that are often key to figuring out aspects of cases.

Celestial objects, such as stars, plan-



Dropping the KML files into Google Earth confirms that the planes line up with the lights at the time of the video.



The Sitrec Open Source tool being used to analyze a Chilean UAP video

ets, and satellites, can be viewed on sites (or apps) such as Stellarium. This allows you to see what the night sky would look like at any time, from any position on Earth. Many UAP sightings are planets, bright stars (such as Sirius), or satellites. Stellarium is clunky but powerful and accurate.

Satellites can be tracked in more detail in sites such as in-the-sky.org, which is useful for checking if you're looking at Starlink satellites. The International Space Station is the most famous (and largest) satellite and is responsible for many UAP reports; there are several sites that track it, including NASA's Spot the Station, and for historical positions there's ISS Tracker.

Weather is often a key component. Sites such as Zoom Earth or NASA's WorldView let you look at a satellite image of the weather on any given day. Earth by Nullschool gives historical wind, temperature, and other weather data in an easy to view map or globe.

There are even databases for things such as lightning strikes (lightningmaps.org) and wind turbines (The USGS Wind Turbine Database). For an example of how databases like this can be combined to solve a UAP video case, see my Science Writer's convention talk, "UAP Investigation with Public Data" (West 2023).

A powerful technique made possible by modern technology is using complex queries on public databases. The prime example of this is Overpass Turbo, which allows you to query the Open StreetMap dataset to find locations that match specific criteria. This can be very useful when investigating a UFO video with limited location data.

In one example on Metabunk, a UAP video in Albany, New York, had a sign saying "Plaza" and a covered bus stop. Using only that data, a query to Overpass Turbo was able to locate three possible locations in a few seconds.

Situation Recreation

More complex reconstructions can be done using an open-source tool I helped develop called Sitrec. Short for "Situation Recreation," this tool was originally designed to analyze the U.S. Navy videos Gimbal and GoFast. It has evolved over several years to be a general-purpose platform for recreating, analyzing, and sharing typical UAP scenarios.

Sitrec's analysis is based around the concept of Lines of Sight. A UAP video is two dimensional, but you can use the information in the video, and the additional data described earlier, to create a set of lines of sight that indicate where the camera is looking at any point in the video.

Once the lines of sight are generated, you can then create a path that traverses those lines of sight. You can create multiple paths, and each one is a possible solution to the UAP video. Paths can also be created by dropping in ADS-B data or using the numbers on-screen to calculate view angles.

For each path, you can then use Sitrec to calculate if the object took that path, how fast would it be going, what g-forces would it endure, and how big would it be. Those numbers would allow you to see if it was possible that the UAP was something mundane, such as a plane, or if the UAP is what ufology has been endlessly searching for—something unambiguously anomalous. ■

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[THE TIME WARP: SKEPTICISM REVISITED—FROM THE FUTURE

CRAIG A. FOSTER

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To Hell with Near Death Experiences

Welcome aboard, friends! In *The Time Warp*, we aren't limited to present-day examinations. We use Skeptical Inquirer's rich history to examine skepticism … *from the future*. On this voyage, we travel to Spring 1979 to breathe new life into SI vol. 3, no. 3.

Some historical events to get us into the spirit of things: The Bee Gee's "Tragedy" replaced Gloria Gaynor's "I Will Survive" as the #1 hit (March 24, 1979). Margaret Thatcher became the United Kingdom's first female prime minister (May 4, 1979). The movie *Alien* introduced sci-fi fans to facehuggers and chestbursters (May 25, 1979).

And the Skeptical Inquirer continued to be our plucky star in the promotion of science and reason.

Some Skeptical Thoughts from the Time

In "Committee Tests," James Randi described the examination of Susie Cottrell, a purportedly genuine magician who had performed on Johnny Carson's *Tonight Show*. A simple cut in Cottrell's card deck cut Cottrell's "magic."

Christopher Scott and Michael Hutchinson tested whether Masuaki Kiyota could project mental images onto camera film. Kiyota was only successful "after the film had been in his possession—and not under any control—for at least two hours" (p. 48).

Philip J. Klass described how J. Allen Hynek went from doubting extraterrestrial visitation to being a central figure in the "we are not alone" community.

Kendrick Frazier summarized the U.S. Geological Survey's study regarding whether members of the public can predict earthquakes. Random predictions outperformed amateur scientists, astrologers, and psychics.

To Hell and Back?

Today is a good day to die … or, at least, to write about dying. Is anything more important than the journey our minds allegedly take after we die physically? In the article "Psychology and Near-Death Experiences," James Alcock—a living legend of skepticism—reviewed the evidence. Alcock's work marked the first time near-death experiences, or NDEs, were the subject of a feature article in the Skeptical Inquirer.

Alcock didn't dispute that NDEs exist. It seems rather obvious that some people have cognitive experiences when they are "near death" (submersible implosions excepted). The fundamental issue for skeptics is whether NDEs provide evidence for the survivalist perspective—the belief that some spiritual component of human existence continues after physical life has been extinguished.

Alcock, not surprisingly, was skeptical about life after death. To start with, NDEs are inconsistent. Some people see tunnels; others don't. Some have nothing to report. NDE-like experiences also occur in far-from-death situations, such as those involving drugs or deep meditation.

Alcock also examined other concepts suggesting that human consciousness can travel beyond the physical body: mystical experiences, out-of-body experiences, hypnagogic sleep, hallucinations, and hypnotic regression. Alcock disputed the notion that any of these areas provide legitimate evidence for soul survival.

One example even involved psychologist Elisabeth Kübler-Ross. Kübler-Ross became known for her five stages of grief, a model that did not rely on the supernatural. However, she went into full survivalist mode based on her own out-of-body experiences. When asked for the scientific evidence to support this type of claim, Kübler-Ross said—invoking a theme tiresomely familiar to skeptics—that such evidence hadn't been published yet.

Alcock also reviewed the Bridey Murphy case that had been promoted as evidence for past lives. The whole affair was easily married to secular explanations. Virginia Tighe, the Colorado woman who wowed contemporaries by channeling her past Irish life as Bridey Murphy, had been exposed to many stories about Ireland as a child. Some of those stories came from a woman whose maiden name was—get this—Bridey Murphy.

The case for survivalism didn't progress much in the years that followed. To illustrate, let's go to 2024 to consider a thoughtful, well-researched presen-

Virginia Tighe claimed to be "Bridey Murphy" in a past life (she was given the pseudonym "Ruth Simmons" in a 1956 film titled *The Search for Bridey Murphy*).

Morey Bernstein using hypnotic regression on Virginia Tighe to help her remember her past life.

tation about NDEs provided by Dr. Keith Brown at the Seattle Skeptics and Science Enthusiasts' SkeptiCamp. The presentation reviewed notable contributions to the debate surrounding NDEs and life-after-death, most of which were published after 1979. Some examples include Moody's book *Life After Life*, Susan Blackmore's SI article (Fall 1991), Todd Burpo and Lynn Vincent's book *Heaven Is for Real* (later made into a movie), Sam Parnia and others' AWARE study, Bruce Greyson's book *After*, and Michael Shermer's book *Heavens on Earth*.

Brown, like Alcock, disagreed with the claim that NDEs provide evidence for life after death. NDEs still vary in quality. NDEs can still be attributed to biological processes. Reports about adjacent mystical experiences, such as out-of-body experiences, still provide no compelling evidence for human existence genuinely occurring outside the mortal coil.

Consider *Heaven Is for Real*, the story about a young boy, Colton Burpo, who reportedly went to Heaven during surgery. The evidence for this supernatural trip comes from Colton's subsequent knowledge about things such as Heaven, Jesus, a deceased relative, his mother's miscarriage, and his father's personal experience while Colton was in surgery.

We know that human perception and memory are prone to mistakes, and long-term memories can be distorted further through the reconstructive process of recall and storage. Hence, how sure can we be about the accuracy of the memories that contributed to this fantastic story? To that we can add the possibility that Colton acquired ostensibly strange awareness through intuition or non-paranormal forms of learning that were missed or forgotten. These known explanations make stories such as *Heaven Is for Real* suspect as evidence for an afterlife, even when they are genuinely believed by their promoters.

Survivalist supporters would likely argue that stories about visiting Heaven are real, and the problem lies with skeptics for being so unwilling to trust them. With that in mind, I'm going to float to a different place to look at NDEs and life after death from a different perspective. The NDE headlights are so dim they do not even resolve fundamentally different religious perspectives about life after death. Survivalist supporters frequently use NDEs to suggest that death takes you to a wonderful, peaceful place. The *Heaven Is for Real* story even suggests that everybody is young in Heaven, nobody wears glasses, and people have wings.

That all sounds lovely, but Bill Wiese—a realtor who wrote a book called *23 Minutes in Hell*—would beg to differ. According to Wiese, death might not lift you to a joyous well-lit location

where you can eat cotton candy and fly around with your twenty-five-year-old grandma. Oh no. Death can be really, really bad. It is Wiese's sincere hope that we listen to him and make good choices.

Is Weise's message about potential damnation believable? Despite all the NDE reporting, Christians don't even know. In a 2021 Pew Research Center poll, only 79 percent of Christians reported believing in Hell (Pew Research Center 2021). Put differently, the Pew poll demonstrates that a notable portion of Christians maintains religious views that are incompatible with purportedly true stories about witnessing Hell. Holy smokes! If Christians can't agree on which personal heaven and hell experiences are credible, why should skeptics believe *any* of them?

I wouldn't care so much if people didn't use NDEs to justify belief systems that are then used to influence public policy. This occurs when some Christians (not all Christians) attempt to undermine public science education or put prayer in public school. All that confidence that they know better, while Christians more broadly can't even tell us whether Hell is real. Talk about tunnel vision.

This is Foster, living member of the skepticism movement, signing off. ■

Note

The views expressed belong to the author and do not necessarily reflect the official policy or position of Northshore School District.

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[SKEPTICAL INQUIREE BENJAMIN RADFORD

Benjamin Radford is a research fellow at the Committee for Skeptical Inquiry and author or coauthor of fourteen books, including *America the Fearful: Media and the Marketing of National Panics*.

Psi on the Blink: Street Light Interference

Q: **For my entire life, streetlights have been affected whenever I walk under or near them. I have witnesses to testify to this, and I'm curious as to what it could be. It's almost like it follows me everywhere I go. Do you know what this could be about?**

—Kate L.

A: The phenomenon by which some people claim to be able to influence streetlights is called street light interference, or SLI. Fortean researchers, including Hilary Evans at the Association for the Scientific Study of Anomalous Phenomena (ASSAP), have researched the subject, though apparently with limited success. An article on the ASSAP website by Gary Rowe (2020) offers a concise definition:

> SLI is an ability claimed by certain people to switch street lamps on or off merely by being in the vicinity … I have only been involved for little over twenty-five years, but I suspect that it is as old as street lighting itself. SLI is closely allied to Traffic Light Interference, which is far more commonly encountered. In traffic light interference the driver of a vehicle believes that by simply "willing" a change to occur, he is able to influence the traffic lights in his favour as he approaches.

Rowe then offers a fairly comprehensive overview of investigational considerations.

This phenomenon, if real, would be mysterious indeed and raises several questions. For one, why streetlights specifically? Why not any other random lights that the person might be nearby, from vehicle headlights to dining room chandeliers and desk lamps? Do they affect any electronics, from watches to televisions to smartphones, or just street lights? This ability would be quite easy to test under controlled conditions—yet it never has. People who claim to have this active ability (or passive effect) say they can't do it on request. They, like Kate, are typically at a loss to explain it and may attribute it to some unknown energy charge (such as, supposedly, chakras or static electricity) or psychic ability.

Massimo Polidoro wrote about this topic in these pages back in 2008. He noted, "It could just be that SLI is a mix of different natural factors. The normal behavior of bulbs getting older, observer bias, and maybe something else, like the fact that some specific lamps, such as those in gardens or on patios, have infrared sensors that can turn them on or off when something is moving within range. Other lamps are programmed

with a timer that turns them on or off at specific hours. Some people realize this is the cause of such changes in the lights" (Polidoro 2008).

The phenomenon is also similar to the discredited ghost hunting technique in which flashlights with fragile connections to their batteries are believed to communicate ghostly messages. Ghost hunters will loosen a flashlight at a supposedly haunted location so that the slightest nudge or pressure will make it blink and then ask any ghosts present to make themselves known by turning the light on (or off). Some ghost hunters conduct entire "interviews" this way, asking yes or no questions ("one for yes, twice for no") about the (likely nonexistent) spirit's biography and the location's history (for more on this, see Radford 2017 and Biddle 2019).

There are several psychological factors at work, including the *post hoc ergo propter hoc* ("after this, therefore because of this" or faulty causation) fallacy and of course confirmation and other observer biases. It is also similar to people who claim to be able to control clouds with their minds, and when they focus on trying to make a distant cloud move or disperse, they find success—if they just wait long enough. I replied to Kate with a mixture of psychology, skepticism, and research design, suggesting she test this herself:

> What you're describing sounds like other stories I've heard, so you may not be alone! The best way to figure out what's going on would be to test this, either alone or with a friend. You'd need to record yourself walking under a series of lights, for example on a street or path (presumably it wouldn't matter if you're alone, unless you think for some reason another person would change things). Then take careful notes of how many you walk under, and of those, how many go out and how many stay on. You of course need to record *all* of them, you can't just note the ones where it *does* happen, because of what in psychology we call *confirmation bias*—we tend to "remember the hits and forget the misses." For example, in your everyday life we don't notice all the times a light *doesn't* go out, but the rarer times when it *does* go out! When we are running late for something we especially notice—and get annoyed by—hitting stoplights, but don't pay as much attention when we're not in a hurry. That sort of thing.
>
> But some streetlights go out (or blink) by random chance, whether anyone is around or not, so in order to know for sure whether it's random or you're affecting it, it needs to be recorded. To get a good sample size it would be best if done on at least 100 lights. I know it sounds like a lot, but to help rule out random chance it needs to be repeated—and anyway that shouldn't take too long, since you could maybe do six or ten at a time in a given location. If you want to experiment with that and get back to me, I'll be happy to take a look!

I never heard back from Kate, so I don't know whether she followed my suggestions and conducted the test or not. Had I heard back from her saying she'd done the test and still believed she had that ability, I'd have replied positively and suggested she contact my colleague Jim Underdown at the Center for Inquiry Investigations Group for a follow-up—and a chance to win $500,000. ■

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Fringe Zoology: The (In)Convenience of Disappearing Evidence

Proponents of cryptozoology attest to the existence of animals evidenced only by testimonial and circumstantial evidence. More definitive evidence has often been claimed to be tantalizingly close at hand yet subsequently lost or spoiled due to camera mishaps, lost specimens, and other *ad hoc* excuses.

FLOE FOXON

Cryptozoology—the search for hidden, unknown, or "out of place" animals—is, by definition, characterized by testimonial and circumstantial evidence (Heuvelmans 1982; 1988). These forms of evidence are insufficient for the subjects of cryptozoology, or *cryptids*, to receive widespread recognition among conventional zoologists. In the zoological sciences, circumstantial evidence *is* inconclusive yet undeniably intriguing. Indeed, consistent, high-quality circumstantial evidence may even motivate more rigorous exploratory investigations in search of conclusive physical evidence, i.e., specimens. But what are we to make of evidence that is persistent but neither consistent nor high-quality? And what about evidence that seems so often to disappear or otherwise elude its investigators (a situation shared by alien implant and crashed saucer advocates, among others)? Is there a mystery at all? This article presents a non-exhaustive selection of occasions on which evidence for purported unknown animals was (in)conveniently lost just as it was at hand.

African Dinosaurs

The Congo River Basin is purportedly home to Mokele-Mbembe ("one who stops the flow of rivers"), large amphibious animals superficially resembling sauropod dinosaurs (Mackal et al. 1982). To date, no physical evidence for the existence of these animals has been presented, and while early expeditions obtained interesting anecdotes from local peoples (Mackal 1987), investigators were unable to obtain conclusive material.

In 1981, The Regusters' African Congo Expedition (TRACE), led by Jet Propulsion Laboratory engineer Herman Regusters, claimed to have encountered such an animal on several occasions in the Lake Tele area (Regusters 1982). Unfortunately, Regusters's report contains doubtful instances of evidence eluding the TRACE team: As to why no photographs of the animal were taken, Regusters explains that "there were times when there were no cameras at hand" (Regusters 1982, 18), that "the humidity destroyed all the film" (Regusters 1982, 24), or that "every member of the scientific team [saw the animal], except the photographer" (Regusters 1982, 13). Regusters also reported hearing the animal "roar" but that "attempts to record the sound on several occasions resulted only in rather poor quality productions" (Regusters 1982, 13).

Two years later in 1983, biologist Marcellin Agnagna led the first Congolese expedition to Lake Tele (Agnagna 1983). On this occasion, expedition members also reported witnessing the animal but failed to produce photographs because "the camera was accidentally set on macro" (Greenwell 1984). In another such account described in a letter written to Roy P. Mackal at the University of Chicago, J.M. Lefebvre purportedly also saw the animal and did not produce photographic evidence. According to Lefebvre, "I had a camera with me, and I did not take a photo—in the first place because I never t[h]ought about it, in the second place because at this distance and with the haze it never works" (Mackal 1987, 212).

Lake Monsters and Sea Serpents

Numerous lakes in the northern hemisphere are alleged to contain large animals putatively identified as archeocetes (ancient whales) or plesiosaurs. Lake Champlain in the United States and Canada is one such lake, whose denizen, the Lake Champlain Monster *Belua Aquatica Champlainiensis* (*nomen nudum*) was famously caught in the lens of Sandra Mansi in 1977. The Mansi photograph has been analysed on a few occasions: Frieden (1984) concluded that the image was probably not tampered with but may feature a sand bar upon which a model monster could have been placed. The size of the subject photographed by Mansi has variously been estimated at 4.8–17.2 meters (LeBlond 1982), 2.1 meters (Radford 2003), and 1.3 meters (Raynor 2015). It is now known that the publication of this photograph in 1981 was associated with a statistically significant increase in Lake Champlain Monster sightings in the years that followed (Foxon 2023). More could be learned from the original photograph, except that the negative is not available for viewing. When interviewed by Benjamin Radford and Joe Nickell in 2002, Mansi explained that she had "habitually" thrown away the negatives and that she could not provide any of the other photographs taken on

Sandra Mansi's 1977 photo of Champ (the negative was thrown away).

the same roll of film. The evidence surrounding the Mansi photograph disappeared.

In his book *Champ Quest*, Dennis Jay Hall (1999) mentions a "little reptile" purportedly representing a baby Lake Champlain monster and purportedly caught by Dennis's father, William H. Hall, that "looked like a snapping turtle would without a shell." Benjamin Radford contacted Dennis Jay Hall by email to inquire as to the whereabouts of the baby Champ specimen, to which Hall responded that "the animal was sent to [the University of Vermont] for identification. They, unable to identify it, sent it to [a high school] where it remained for years. The animal was accidentally thrown away during the Summer of 1990 when the biology lab was upgraded" (Radford 2020).

Similar animals are claimed by some to inhabit the oceans, but these too seem plagued by evidential misfortune. Commander of the *Avalanche*, Lieutenant Lagrésille, reported a sea serpent sighting in the late 1800s, giving chase but returning empty-handed. According to Lagrésille, "Two of the officers present possessed a camera: they ought to have been able to use it then, but they were so surprised by what they saw, that when they thought of aiming their cameras the animal dived, only to appear much further away in much less clear conditions, unfavourable to taking a photograph" (McEwan 1978, 41). When David Clarke reportedly encountered the Morgawr sea serpent at the mouth of the Helford River in the 1970s, allegedly invoked by "magical means," Clarke could not produce photographs of the long neck and small head protruding from the water because, as McEwan (1978, 66) reports, "the winding mechanism of Clarke's camera had slipped repeatedly, so all the negatives were double exposed."

On occasions when sea serpents were reportedly captured, various reasons have been given for the specimens being lost. Captain S.W. Hanna of the *Pemaquid* claimed to have discarded the body of a 7.6-meter eel-like monster, explaining that "I did not save the fish for the reason that I did not know what I had caught. In fact, I considered it a streak of ill-luck rather than good fortune, having torn my nets very badly and otherwise bothering me in my business" (McEwan 1978, 87). Another monster carcass, or *globster*, thrown ashore in South Africa was "washed away by the spring tide before it could be examined by experts" (McEwan 1978, 90). In 1918, naturalist Samuel L. Mitchill discovered teeth and a large fossil vertebral column in North Carolina, which Mitchill believed belonged to a giant sea serpent (Greenfield 2023). In 1866, "Mitchill's Monster" was destroyed in a museum fire, having never been illustrated, confounding subsequent examination of the specimens. Paleontologist Tyler Greenfield (2023) suggests that it was "most likely baleen whale vertebrae with associated teeth of the megatooth shark."

In 1949, a primitive fish scale apparently having originated from a large coelacanth-like fish was reportedly retrieved in the Gulf of Mexico by a fisherman (coelacanths are not known to exist there), being subsequently sold to a craftswoman in Florida, who shared it with an ichthyologist at the Smithsonian National Museum of Natural History in Washington, D.C. (Heuvelmans 2006). The ichthyologist was reportedly unable to obtain any further information from the craftswoman regarding the origin of the scale, and Karl Shuker (1995) reports that the scale was "somehow lost, and has never been traced."

Cryptids Down Under

In the mythopoetry of the Indigenous Australians, the bunyip or Melong is an amphibious swamp-dwelling animal of monstrous nature, interpreted by some Westerners as a real animal (Kerr 2003). An "unusual skull" (or skull fragment, depending on the source) putatively attributed to the bunyip was found in 1846 along the Murrumbidgee River in New South Wales and was identified as a horse skull by naturalist W.S. Macleay and a cow skull by comparative anatomist Richard Owen (Heuvelmans 1965, 116). The specimen was famously displayed at the Australian Museum in Sydney, after which it reportedly disappeared (Budd 2010, 30). Kerr (2003) suggests that the skull was merely a publicity stunt by the museum to market their collections by insensitively capitalizing on indigenous culture. The following year, in 1847, two depictions of bunyip from Victoria, purportedly drawn by indigenous Australians, were supposedly sent to Tasmania but "vanished," never arriving at their destination (Heuvelmans 1965, 117).

On the nearby islands of New Zealand, indigenous peoples and Western settlers alike have claimed sightings of live moa, giant flightless birds once endemic to New Zealand but thought to have been exterminated circa 1300 CE by the first Austronesian settlers in a rapid "overkill" (Holdaway et al. 2014). As with other cryptids, physical evidence for their survival after the arrival of Westerners to New Zealand in the eighteenth century has not been confirmed, though specimens have been claimed to exist. In his autobiography, whaler Burr Osborn (1892) described catching, in a pit in 1845, one "big emeu … nearly or quite extinct … a monster bird … weighed about 500 pounds." Osborn continued: "the captain was a pretty good taxidermist and after putting him up said he was going to send him to the London museum." Alas, the 500-pound bird

was never received by the London Museum or any other museum in any other country; the specimen simply disappeared. In 1961, Grace Adams (1968) and her parents allegedly found perfect impressions in the sediment near Lake Misery that had apparently been made by an enormous bird. They intended to take plaster casts but reported that the tracks were washed out before they had the chance to do so. Vida Lucock, an experienced bushwoman and outdoor education instructor, as well as four other trampers reportedly saw baby moa in 1976 along the Heaphy Track in Kahurangi National Park, but apparently they were so dumbfounded by what they saw that they forgot they had cameras with them (Spittle 2010).

Mystery Big Cats

The existence of a large, unknown felid in Mexico called the "onza" and described as a slender cougar has been claimed on numerous occasions and was at one time speculated to be a surviving American cheetah (Hemmer 1985). According to Greenwell (1985), in 1938, a cat putatively identified as an onza was killed in Sinaloa, and the skull of this animal was examined inconclusively in the 1950s. This specimen, the Shirk skull, was believed to have been deposited in a museum collection in the 1960s but was reportedly lost thereafter. A cat skull from the same area was found at the Academy of Natural Sciences in Philadelphia, but comparison between that skull and photographs of the Shirk skull suggest that they may not have been the same specimen.

Peter Hocking (1992; 1996) of the Natural History Museum in Lima, Peru, described other mystery big cats in South America: the giant black panther, the speckled tiger, the striped tiger, and the jungle wildcat—possibly melanistic known forms—that have purportedly been killed by hunters with skins preserved, but none could be obtained whole. Hocking says the skin of the speckled tiger was promised to him but never received, having purportedly been sold to someone else. The skulls of a striped tiger and an "anomalous jaguar" (whatever that means) were obtained by Hocking, and a morphometric analysis by Darren Naish et al. (2014) suggested that these belonged to jaguar. However, the skins of these animals, which would prove their unique coloration, were missing when the skulls were sold.

More American Mysteries

Numerous reports have been made of enormous snakes far exceeding currently accepted records of twenty to twenty-four feet (Barker et al. 2012; Ehrsam and Barker 2022). On a diplomatic mission in Brazil, a snake allegedly measuring seventy-five feet was purportedly shot and killed, but this significant serpent was not photographed because authorities "had forbidden them to take cameras," and its remains were not recovered because, according to one expedition member, "none of us seemed to realize that there was anything exceptional about our prize. There were no zoologists among us … we had neither the time to skin the beast nor to prepare its hide" (Heuvelmans 1965, 170). In another such instance, a snake reportedly measuring 115 feet in the River Oiapoc, killed by "500 machine gun bullets" was "pushed back in the stream at once" rather than being preserved, because, Heuvelmans (1965, 174) suggests, "its skin was of no commercial value."

Before the arrival of humans, the New World of the

Americas had only monkeys and no apes. Controversy arose in the early twentieth century when Swiss geologist François de Loys and companions claimed to have shot and killed an unknown ape near the Columbia-Venezuela border (Heuvelmans 1965, 183). Although a single frontal photograph of the animal was taken, it is generally accepted that this "ape" was in fact a spider monkey, which are common in the region. The rear of the animal, which would confirm or refute the presence of a tail, was not photographed. Proponents of "Loys's Ape" argue that the specimen photographed was too big to be a spider monkey, while skeptics argue that its apparent size is an optical illusion. The skull of the animal, which would have settled the debate once and for all, was purportedly lost because "the expedition's cook who prepared and preserved the animal's skull was rash enough to turn it into a salt box. It dried and disintegrated in the heat and little by little the pieces were lost" (Heuvelmans 1965, 185).

Another infamous ape that appears to have gone missing is Bigfoot or Sasquatch. As Radford recently wrote, "Bigfoot is nowhere to be seen" (see Radford [2024] for a scoping review). Many putative hairs and casts of putative tracks have been attributed to Bigfoot, but none to date have been widely recognized by experts in the zoological sciences as having originated from hitherto unknown American primates. As an example, the "Skookum cast" was an animal cast taken by the Bigfoot Field Research Organization (BFRO) in the Gifford Pinchot National Forest for an episode of the *Animal X* television series. The BFRO attempted to capture footage of the enigmatic "ape" with thermal imaging devices, by deploying "scented discs laced with sex hormones of female primates," and by using "sophisticated audio equipment that broadcasts tape-recorded calls of a Sasquatch" (quotes taken from the episode). After hearing some spooky sounds but being unable to capture footage other than a "nondescript hotspot" that turned out to be a rock, the BFRO (2000a) reported that "the film crew ran into a problem with both the thermal camera and the infra-red camera shutting down due to excessive moisture getting into the components." Therefore, a shift in strategy was made by the BFRO to lure the animal by placing fruit in mud. The next morning, large animal prints, which were cast with gypsum, were found around the bait. Parts of the cast were quickly likened to the "buttocks" and "testicles" of Bigfoot (Hume 2001). Radford was reportedly denied access to the cast (Radford 2024), which was subsequently identified as an elk wallow (Hume 2001; Perez 2007; Radford et al. 2007)—i.e., the impression made by an elk as it rolls around in a puddle of its own urine to attract females. Maybe those pheromones did something after all? The BFRO themselves noted that "the entire area [of Skookum Meadow, Gifford Pinchot National Forest] supports robust populations of elk" (BFRO 2000b), that a "survey of the immediate area did turn up sign[s] from a variety of animals, including black bear, coyote, elk, deer, and cougar" (BFRO 2000c), and that there were "elk, deer, coyote and bear tracks in the mud pool [where the 'Bigfoot' cast was taken]" (BFRO 2000d).

De Loy's "Ape"

Conclusion

Is missing evidence an inconvenient but honest explanation for instances when zoological discovery has been thwarted by chance misfortune? Or is missing evidence a convenient excuse for hoaxers, the proverbial "monster ate my homework"? If the evidence was rediscovered and found to be weak, would proponents of cryptozoological methods abandon hope for the existence of cryptids? Equally, if the evidence was rediscovered and convincing, would conventional zoologists accept the existence of cryptids? All good questions for the skeptic to ponder. For more related ponderings, check out my new book, *Folklore and Zoology*. ■

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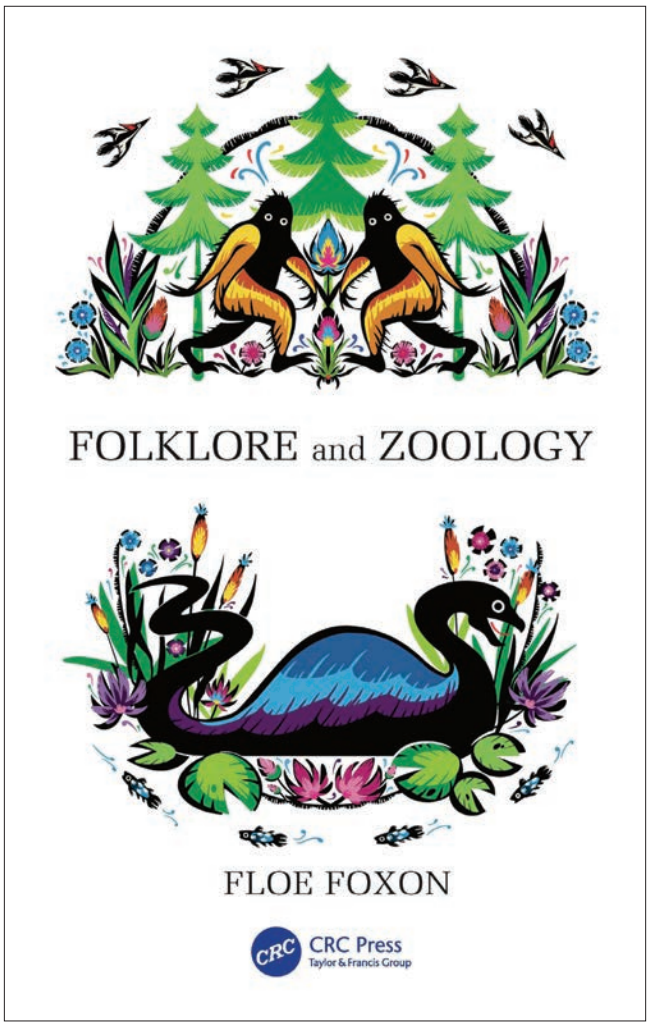

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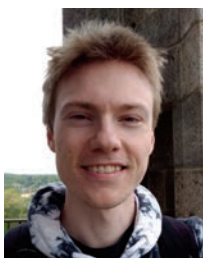

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The Wim Hof Method: Ice Baths, Risky Breathing, and the Goop Lab

The Wim Hof Method consists of breathing exercises and cold baths, promoted as a key to good health and a cure for all ills. There is, however, no good evidence that the Wim Hof Method cures anything—and, in fact, the breathing exercises may be dangerous.

MARTIN BIER

In the winter of 2014, neighbors and passersby wondered why Wubbo Ockels was submerging himself in the cold and dirty water of the canal in front of his house in Amsterdam. Wubbo was a celebrity in the Netherlands. In 1985, he was part of the crew of the space shuttle *Challenger* and became the first Dutchman in space. He had an engaging personality. After his space mission, he was often seen on TV and hosted a popular science show. He also advocated for sustainable development and green energy projects. It was after getting a diagnosis of kidney cancer that he turned to "Iceman" Wim Hof.

Hof had long been interested in yoga, meditation, karate, extreme physical feats, etc. He was already well in his forties when well-publicized stunts involving extreme cold brought him fame. He swam 200 feet under ice. Bare-chested and bare-footed, he ran half marathons in subzero temperatures. On several occasions, he spent about two hours in a tank filled with ice cubes while wearing only briefs and with just his head sticking out above the ice. More than once, the stunts landed him in the emergency room and even the intensive care. It all led to Hof being a household name in the Netherlands by 2010.

Style and approach shifted around Hof's fiftieth birthday. The circus and spectacle were toned down. Instead, research and education were brought to the foreground. The stuntman morphed into a guru. In 2011, the company Innerfire BV was founded, and the Wim Hof Method became a brand. Cold exposure and breathing techniques were sold as a key to health and happiness. Hof became a motivational speaker; he began organizing workshops and took on consulting work. Customers could join Hof on a one-week midwinter retreat in the Sudeten Mountains in southwest Poland. There yoga in the snow, jumps in freezing ponds, and strenuous hikes wearing only shorts were on the program.

Wubbo Ockels joined on such a retreat in February 2014. Shortly before the trip, Ockels, Hof, and a handful of other devotees of the Wim Hof Method appeared on an authoritative Dutch TV talk show (https://www.bnnvara.nl/pauwenwitteman/videos/258284 in Dutch). Ockels reports there that he is feeling great, but that he is joining the expedition to Poland so the immune system can finish with the complete cleaning of all the cancer. Two other people at the table—a multiple sclerosis patient and an arthritis patient—describe how the Wim Hof Method gave them back a normal life.

Hof next points out that the method has three pillars. First, there are the breathing exercises "through which you go deeper into the nervous system." Next, there is the getting used to cold "to train the cardio-vascular system which leads to stuff reaching the immune cells." And finally, there is the mindset: "neurotransmitter making better connections with the body."

When pressed by the interviewers, Hof denies that he is making any hard medical assertions. But the disclaimer is followed by an account of how medical doctors refer people to him that they have given up on and how Hof turns these patients into success stories. He talks about "waking up powers that are inside every human being" and how "*you* are the miracle that you can cause yourself."

Just three and a half months after the broadcast, on May 18, 2014, Ockels died at sixty-eight. In an interview in July 2014, Hof said "I never claimed that I was able to cure him, only that I could make him stronger … he was too far gone already" (Zuidweg 2014).

Cryotherapy and Risky Breathing

It is a cliché that a therapy or theory must be valid if it has survived for a long time. But bloodletting and astrology show that this idea is mistaken. The best way to establish the effectiveness of a medical treatment is a double-blind clinical trial with a control group. About half of the subjects receive the "real thing" (e.g., an active ingredient) while the other half receives a sham treatment or placebo. The "double-blind" means that for each individual case, neither the patient, nor the treating physician knows whether what is administered is real or fake. In the end, it is the statistician who gets all these data plus the outcomes. The statisticians know who is in which group, and they ultimately figure out whether the real treatment has a statistically significant edge—that is, whether or not it is effective.

It was in the 1980s that "whole body cryotherapy" was

A demonstration by "Iceman" Wim Hof in Rotterdam on March 24, 2007. Source: aad | Flickr.

first studied with a degree of scientific rigor. With special cold-air chambers in which all variables are under control, clinical studies were undertaken. The Wikipedia page about cryotherapy describes some of the outcomes. No spectacular results emerged. An obvious obstacle to getting hard conclusions is, of course, that no sham or placebo is possible when the treatment consists of exposing the patient to extreme cold. Many studies involved just a few patients and could only be considered preliminary. Evidence of the efficacy is lacking, and there are actual risks associated with exposure to cold. In short, the possible benefit is not worth the risk.

Breathing is the other pillar of the Wim Hof Method. Participants are instructed to breathe deeply and rapidly, i.e., to hyperventilate. After doing so for a few minutes, they are supposed to hold their breath for a few minutes. *Hypoventilation* is the medical term for this. Medical science may not exactly know all the effects of application of extreme cold, but what hyperventilation and hypoventilation do is very well understood.

Suddenly holding your breath after a bout of heavy breathing, i.e., hypoventilation after hyperventilation, is particularly hazardous. Hyperventilation leads to the lungs holding a high oxygen concentration and a low carbon dioxide concentration. Upon next holding one's breath, the oxygen concentration decreases as the carbon dioxide concentration increases. It is then possible that the oxygen concentration gets too low before the carbon dioxide concentration gets sufficiently high to give a strong impetus to take a breath. Passing out is the result. Many healthy people have drowned through what is commonly called shallow-water blackout.

Instructing people to hyperventilate or hypoventilate in the vicinity of baths or pools—especially alone—is a very bad idea.

Support from Celebrities and the Goop Lab

The Netherlands is a small country. It has eighteen million people and is about twice the area of New Jersey. You cannot be world famous just in the Netherlands; taking your venture to the land of opportunity is the next logical step.

The American endeavors of Hof and Innerfire BV have been fruitful. Cold baths are becoming more fashionable in America and the name Wim Hof rapidly pops up when searching "cold bath." Hof's 2020 book *The Wim Hof Method* made *The New York Times* bestseller list, and he has been interviewed on *The Joe Rogan Experience*. He has also made appearances on shows of Russell Brand and Jordan Peterson. Celebrities such as Kendall Jenner, Madonna, and Lizzo have all become ice-bath-devotees and Hof followers. Even quality news outlets such as *The New York Times* and the *Smithsonian* feature articles about the trend—articles with very little critical analysis and a lot of enthusiastic adulation (Learn 2018; Williams 2022).

The biggest success was when, in 2020, Hof was the central figure in the second episode of the Netflix series *The Goop Lab with Gwyneth Paltrow*. The Goop Lab has taken the advancement of dubious health claims to a new level, and it has already been much discussed (Palmer 2020). Of course, the show is supposed to "entertain and inform" and not provide "medical advice." But—as with the Dutch talk show—the upfront disclaimer comes across as absurd when the next half hour is just an unashamed promotion of the Wim Hof Method with intermittent breaks for two-minute testimonials of happy patients.

Like myself, Hof was born in 1959 in a lower-middle-class environment in the Netherlands. At the age of twelve, he was sent to vocational school. He has no formal medical or scientific training. His background is far removed from the wealthy and wellness-obsessed California of Gwyneth Paltrow. Dutch culture does not feature self-help books at the check-out counter of the grocery store. "Act normally, that's already crazy enough" is as much psychobabble as you may ever encounter in the Netherlands.

It is therefore all the more astounding to see how smoothly Hof relates to Paltrow and her team when he appears on the show. His huge size and crude appearance form a sharp contrast with Paltrow and her associates. Hof gives Paltrow a hug and blazes with self-confidence as he proclaims utter nonsense about immune systems and hormonal imbalance. His meaningless verbosity is interspersed with guru platitudes about how he is merely helping people in the development their own potential. We hear things such as "You become the alchemist of life itself" and "Follow your feeling. Your feeling is the guide. Don't force the guides." Halfway through the show, we see him do yoga barefoot in the snow. "Snowga" is what this is apparently called.

Hof instructs Paltrow and her entourage to do the rapid heavy breathing routine. Paltrow ominously mentions twice that it makes her feel like she is going to pass out, but nothing is made of this. Just once during the breathing exercises, Hof tells the group that they should not do it while driving

or when in a pool. However, not much later we see how the same people do exactly this kind of breathing right before a winter jump into Lake Tahoe.

Already in 2016, an article in the Dutch newspaper *Het Parool* listed pool drownings that were possibly related to Hof's breathing exercises (Duin 2016). Problematic is of course that an autopsy cannot reveal whether a drowning was preceded by Hof's breathing regimen. Therefore, evidence that these exercises were involved was circumstantial.

Devotees, Apostacy, and Claims of Abuse

Devotees of the Wim Hof Method eagerly point to an article that appeared in 2014 in the prestigious *Proceedings of the National Academy of Sciences* (Kox et al. 2014). There it is reported how Dutch scientists recruited twenty-four volunteers. Twelve of them received an extensive ten-day training program in the practices of the Wim Hof Method, and the remaining twelve were the control group. Group assignment was random, and some beneficial effects of the training were found. But the setup of this trial was of course far from double blind, and *demand characteristics* biases may be a serious issue here. This phenomenon is well-known among clinicians and refers to the fact that participants may modify their behavior and responses if they are aware of the experiment's purpose. Commonly, subjects want to be cooperative and contribute to an experiment's success.

The Wim Hof Method is like chiropractic, homeopathy, and acupuncture in that it pretends to be a health-and-healing system that is based on science. But more than these other dubious approaches, the Wim Hof Method comes with religious ritual and a personality cult. In the *Goop Lab* episode, we see how six people do the breathing exercises while lying stretched out on the floor in a circle with the feet all together in the center of the circle. In other videos, we see rituals that are mindful of baptism. Hof is always center stage. In the *Goop Lab* episode, Paltrow introduces him as "the living example of mind over matter." Not much later, Hof is given prophet status when she asks him "Do you ever think about why you are the chosen person to discover this and brought it to the world?" Hof's answer is a cliché: "I see my function now: to help millions and millions of people." In the *Goop Lab* episode and in many other videos and articles, Hof recounts how he suffered a traumatic loss when he was younger and how he was a lost soul until he found redemption through The Method.

As is common in cults, it is inevitable that apostates emerge. Scott Carney is an American journalist with a record of debunking quackery and pseudoscience. He initially took this critical attitude to Hof, but he ended up being converted and writing an enthusiastic book about Hof and The Method (Carney 2018). However, ultimately he turned, and, in 2023, he created a critical website about the Wim Hof Method and the surrounding culture (see scottcarney.com).

September 2024 brought new developments. Hof's ex-wife and their children came out with their story. Two journalists from the Dutch newspaper *De Volkskrant* had done a thorough investigation and published a long article. A free English translation of the article was made available by the newspaper (https://www.volkskrant.nl/kijkverder/v/2024/the-outside-world-knows-wim-hof-as-the-eccentric-iceman-his-family-suffered-domestic-violence~v1176564/). In short, Hof terrorized his family. Police reports, hospital records, court documents, and emails back up gruesome stories of abuse and domestic violence. At this point, it remains to be seen to what extent these revelations will hamper Hof's international exploits.

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There is nothing wrong when someone feels reinvigorated after a cold bath or shower and makes it part of a daily routine. Likewise, meditation is a wonderful thing if it makes someone feel or function better. But the Wim Hof Method is based on poorly substantiated claims about health benefits of an exercise regimen that may be actually hazardous.

For over thirty years, Wubbo Ockels stood for science, engineering, and common sense. It is sad that, in the end, he became one more instance to illustrate that critical scientific judgment toward poorly substantiated medical treatment is often thrown out the window when faced with fatal disease and imminent death. And it's also sad that there are always those who appear willing to recklessly profit from the despair of people that face a serious health crisis. ■

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Martin Bier is a professor of physics at East Carolina University. At the age of twelve, he devised a way to fly on his bicycle. But not much later he figured out that the design involved violations of basic laws of physics. Later again, he obtained advanced degrees in physics and mathematics from the University of Amsterdam and Clarkson University.

The Genetic Book of the Dead Masterfully Illustrates Science Is Brimming with Wonder and Curiosity

BERTHA VAZQUEZ

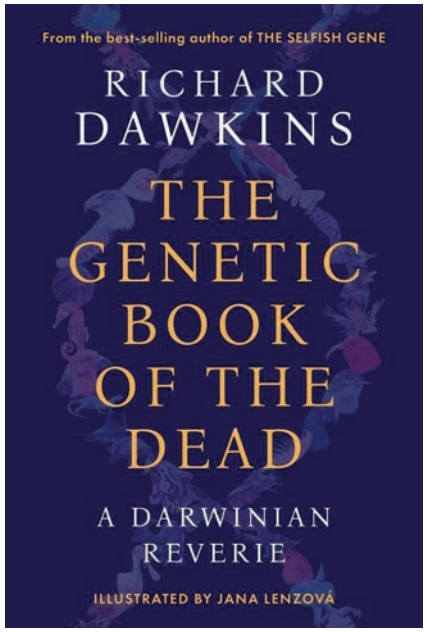
On many occasions. I've heard people remark about how they object to the cold, heartless view of life presented in Richard Dawkins's first book, *The Selfish Gene*. Such a comment is a surefire indication that the speaker has never actually read the book; they've only read the title and misinterpreted the viewpoint entirely. His latest book, *The Genetic Book of the Dead*, masterfully illustrates why *The Selfish Gene* could have just as effectively been titled *The Cooperative Gene*, for it reiterates many of the concepts presented in *The Selfish Gene* and its follow-up, *The Extended Phenotype*.

The common thread in all Dawkins's books is the enchanting notion that science is a realm brimming with both wonder and curiosity. While the title of his latest book might conjure up images of Egyptian papyrus and funerary spells, it won't guide anyone on their posthumous journey through the underworld. It will, however, take the reader on a captivating voyage through the extraordinary diversity of the survival machines we call living things. From the unfortunate little naked mole rat to the beautiful leafy sea dragon, his passionate zoological discourse is contagious.

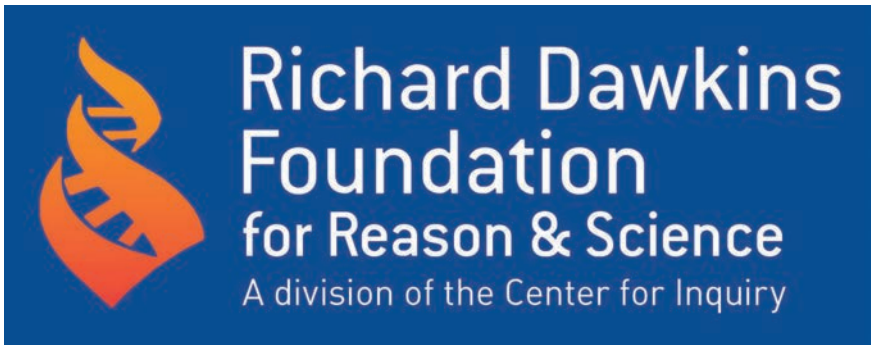
Early on, Dawkins introduces the idea of a palimpsest, a manuscript that has been erased and written over again. Palimpsests are important historical artifacts because they can reveal information about the original texts that were erased, providing valuable insights into the intellectual and cultural history of a particular time and place. Similarly, modern living things are palimpsests of the series of ancestral species that came before them. The central tenet of the book is that every living creature's body and behavior can be read as a manuscript filled with the stories of its ancestors, a compelling argument rooted in the principles of evolutionary biology. We can see traces of these ancient organisms in the intricate details of their descendants' anatomy, physiology, genetics, and behavior. Today, we gain insight into past lives from a modern organism's phenotype, but the scientists of the future will ascertain much more information through each organism's complex genome.

Through important evolutionary concepts such as radiation and convergent evolution, the reader is invited to ponder how the bodies of living things evoke memories of ancient lives and habitats. Our pilgrimage through life's palimpsests would begin in the seas. Some species, Dawkins notes, take a particularly circuitous trip. Tortoises are wondrously multi-layered historical manuscripts. They start out in the sea, move to land, and return to the sea before returning once again to land. The scales of camouflaged lizards recall images of Permian deserts. Tiny moles remind us of the mossy underground world inhabited by its Eocene ancestors. Jana Lenzova's colorful and vibrant artwork can make the many "palimpsests of wonder" contained within the pages come alive.

Because Professor Dawkins is so fond of analogies, I'll try a couple myself. For those of you with a background in biology, his book is like entering a familiar building through a different entrance. You may be familiar with the astounding examples of survival strategies presented, but Dawkins's literary prowess helps you see them from a fresh perspective. All readers might also relate to another analogy: *The Genetic Book of the Dead* is like embarking on an adventure in a playground for your mind, where new equipment has just been installed. Some ideas will be familiar, but there will also be new ladders and slides to explore.


From the best-selling author of THE SELFISH GENE
RICHARD DAWKINS
THE GENETIC BOOK OF THE DEAD
A DARWINIAN REVERIE
ILLUSTRATED BY JANA LENZOVÁ

The book will make you consider fascinating questions. Science does not have all the answers—and that's part of the fun. It allows Dawkins to specu-



late. What will a biologist of the future learn from deciphering an organism's genome? Will they be able to resurrect extinct organisms using ancient DNA? Do bats hear in color? Can dolphins really sense if a woman is pregnant? Do lower organisms experience more pain than their more cognitively gifted cousins? How do cleaner fish "know" that it's safe to enter the mouth of a predator? Can we call it "trust"?

The main idea of the book is that genes are immortal, gliding through generation after generation of living things. The physical bodies of these living things are cast off as they die. Natural selection may sculpt living species as time moves through earth's many geological eras, but it's the successful genes that carry on, moving from individual to individual and ancestral species to descended species. Biologist Denis Noble has been making headlines criticizing the idea that genes are the sole driving force of evolution. He argues that cells, which contain DNA, are also important units of reproduction. Dawkins argues that this is incorrect. Cells, like bodies, are temporary, while DNA is essentially immortal. DNA, not cells, is passed down from one generation to the next.

Furthermore, while any gene that benefits an organism can achieve its goal of making it to the next generation, genes that work well together within said organism aid in each other's transmission to the next generation. Some viruses have no regard for their hosts, using them only as vectors to pass on their DNA, but genes act like viruses whose end goal is intimately tied to their hosts. Our genes and physical bodies exist in splendid mutualism. This leads to the final sentence in the book, where Dawkins takes the concept of the selfish (or cooperative) gene to its final iteration; he tells us, "You are the incarnation of a great seething scrambling time-traveling cooperative of viruses." (Interestingly, around 8 percent of our genes are derived from viral genomes.)

Bertha Vazquez is the Center for Inquiry's director of education.

A Lesson in Phoney Credentials

KAT MCLEOD

Reports of common cons are in the news almost weekly. From grandparent scams to sextortion, new cons seem to regularly reach new lows as they fleece people for their hard-earned money. While it is nothing new, degree mills and falsifying credentials are two of the most prevalent cons. Whether it is a one-off attempt to boost a resume or using a degree mill to make money, embellished credentials are rampant. It seems that no one is safe—not even those who trained to know better.

John Bear, coauthor of the book *Degree Mills: The Billion-Dollar Industry That Has Sold Over a Million Fake Diplomas*, has been engaged by the FBI in diploma mill investigations for over twenty years. He estimates that the thriving industry of degree mills generates $1 billion worth of fake degrees worldwide annually. Former FBI agent Allen Ezell, the book's coauthor, estimates over half of the PhDs issued each year in the United States are fake (Szeto and Vellani 2017). Deviously, some of the degree mills have created false degree verification departments for any third party who requests transcripts or proof of the credential (Szeto 2017).

In 2017, a Toronto lawyer was even deceived by someone with a fake law degree. He hired this person to manage his new law office after being introduced by a trusted acquaintance. The victim asked for his "transcripts, reference letters, and his university diplomas, which appeared to be legitimate" only to discover later that they were forged, and the "manager" was preying on vulnerable immigrants, convincing them to give him money to bring family members to Canada as part of the con (Johnson 2017).

Working at a university, I am well acquainted with forged documents and credentials. I have learned to always verify documents and look for any inconsistencies or errors in the documents. I know not to trust something just because it looks legitimate. Forged documents aren't the only way to fake credentials, however. Sometimes even the students don't realize that they are being conned. Instead of paying for transcripts and degrees they know are fictitious, students will pay large sums of money, attend classes (usually online), and receive instruction to obtain what they believe are legitimate skills and credentials, which are in fact bogus or are misleading. For example, a degree in applied kinesiology is very different from a

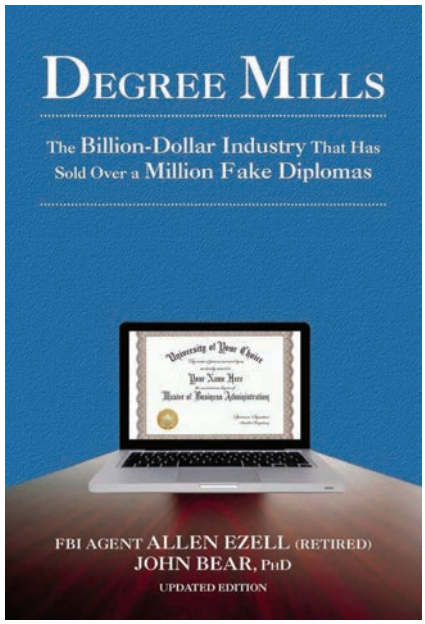
degree in kinesiology; *applied* kinesiology is pseudoscience, whereas kinesiology is based in actual science.

A stunning example occurred in 2023 when an investigation reviewed the relationship between the Calgary Police Service (CPS) and an unaccredited college that offers mental health care training (Milen 2023). In this instance, Robert L. Perkins, a self-described "expert in the prevention and treatment of PTSD" had established a close relationship with the CPS through his College of Certified Psychophysiologists, which was based out of a post office box located in a strip mall in Anaheim, California.

The "college" provided instruction to about twenty people in the CPS. It granted two PhDs in psychophysiology, certificates in police mental wellness, and an honorary doctorate to a CPS sergeant. A simple internet search found that Perkins awarded another honorary doctorate in May 2019 to the founder of Camp My Way, a wellness camp based in Vancouver, British Columbia. While the final report is redacted, it is estimated that CPS spent about $30,000 of taxpayer dollars on this education without doing due diligence by looking into Perkins or the school (Rusnell 2023).

Had the CPS dug a little deeper, they would have uncovered that Perkins's LinkedIn profile is unbelievable. He has given himself the title of "doctor" and claims to have degrees; however, he doesn't state where the degrees are from and lists no formal education on LinkedIn. His resume is riddled with inconsistencies and timelines that don't add up. The college's faculty list has the same woman listed under two names—Veronica Maxwell and Sharon Rowley—and both are actually Perkins's wife. Perkins has also used the alias Amani Maxwell (Rusnell 2023).

Neil Kirkpatrick (a clinical and police psychologist and adjunct professor at the University of Washington) tried to warn the CPS and several other police services in the United States about Perkins. Kirkpatrick discovered that Perkins had set up a phony university, complete with a bogus licensing board (granting himself a license), several bogus nonprofits and charities, as well as fake academies for police chaplains. There are at least nine


DEGREE MILLS
The Billion-Dollar Industry That Has Sold Over a Million Fake Diplomas
FBI AGENT ALLEN EZELL (RETIRED)
JOHN BEAR, PhD
UPDATED EDITION

separate businesses, including a Baptist church linked to the Anaheim post office box. Most of Kirkpatrick's warnings were unheeded (Rusnell 2023).

Perkins falsely claimed to have been published in the *New England Journal of Medicine* about COVID-19 traumatic stress syndrome. He has written a book and has a webpage where you can buy chaplain's badges. Perkins posted photos of himself in what appears to be a police chaplain's uniform with clearly photoshopped Canadian chaplain and California chaplain badges. He has referred to himself as "Reverend," claiming he became an ordained minister in 2002, and worn a chaplain's uniform while attending police events. He purports he became licensed by the International Fellowship of Chaplains; however, they disavow that claim. Perkins and his wife were also active in Toronto's kink and fetish scene, using the aliases Amani and Veronica Maxwell (Rusnell 2023).

Lastly, in 2019, a whistleblower contacted the FBI alerting them to a scheme where for $17,000 people could buy a diploma, a transcript from an unaccredited Florida nursing school, and get tutoring to pass the nursing licensing exam without ever taking a class. This led to an international investigation (delayed due to COVID-19) dubbed "Operation Nightingale" that resulted in indictments for twenty-five people, with investigations ongoing (Bernstein 2023).

Whether it is a phony college giving unqualified training to police officers or degree mills pumping out bogus degrees and certificates for teachers, professors, nurses, engineers, counselors, dentists, or doctors, ultimately false credentials put the public at risk. Employers need to be diligent about asking for credentials as well as ensuring that they are genuine and from accredited institutions to help curb this pervasive deception. ■

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Kat McLeod hails from Edmonton, Alberta, Canada. She is an atheist who is passionate about dispelling misinformation, especially regarding alternative "medicine." When not working at her day job at the University of Alberta, she volunteers to mentor medical students, creates art, and enjoys mingling with other like-minded skeptics and heathens. Writing and photography have been lifelong passions; she has also been a contributor for the ***Skeptic Zone*** podcast. She can be reached at kittycornerskeptic@shaw.ca.

FUN & GAMES

Edited by Stephen Hupp

YOU CAN FIND THE ANSWERS TO THESE GAMES IN SECRETS REVEALED (P. 72).

1	2	3	4
2			
3			
4			

HIDDEN MESSAGE SEARCH

All these letters combine to make a hidden message with each letter being used one time. To find the message, connect the letters by going right, left, up, down, or diagonal (even within the same word). Word count = 5.

U	O	H	S	S
L	N	E	R	D
D	E	T	H	E
G	D	M	U	H
U	I	A	N	S

THE PLANETARY SOCIETY

SKEPTICROSS

ACROSS

1. What Nye does to the world (on Netflix)
2. What happened to Pluto (from the list of planets)
3. Students don't ____of Nye
4. Number on every Nye book

DOWN

1. Institute that searches for intelligence
2. X (on a graph)
3. Role of "Is" in *The End Is Nye* (on Peacock)
4. Creationism's birth (debatable)

WORD NOODLE

"Make a new seven-letter word (green = correct letter and position; yellow = correct letter; black = wrong letter). ***Clue: This one should be easy for BILL NYE.***

B I L L N Y E

ANTIQUE MALLARKEY

Acquired from the Lawrence Antique Mall in Lawrence, Kansas, the Bill Nye The Science Guy Way Cool Game of Science prompts players "to get security clearance into NYE LABS and become the RESIDENT SCIENTIST in as many labs as possible." Like the Trivial Pursuit game, players answer questions in several categories including 1) Yellow—Freaky Fun Physics Lab, 2) Blue—Exceptionally Excellent Earth Lab, 3) Green—Big Bubblin' Bio Lab, 4) Purple—Vastly Hugely Big Space Lab, 5) Orange—Kooky Cool Chemistry Lab, and 6) Red—Hip Happenin' Human Lab. Players may even "have to face Bill in the NYE 'Q' TEST."

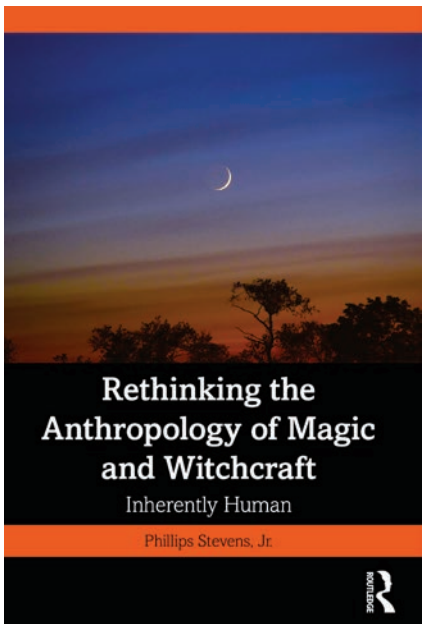
Inherently Human: New Approach to Magic and Witchcraft

Autumn Sword

As Phillips Stevens Jr. points out in his new book *Rethinking the Anthropology of Magic and Witchcraft*, while there is a popular fascination with the occult, most of the scholarly literature over the years has discussed the subjects of witchcraft and magical thinking from a functionalist perspective—asking what these beliefs do for the cultures that act upon them. The title of the book teases Stevens's unique approach: by combining an anthropological study of magic and witchcraft with the insights of modern neuroscience, we learn that these are inherently human ways of worldbuilding. Magical thinking, he argues, had adaptive benefits for our ancestors, and, like other human behavior, the practices of witchcraft and magical thinking are therefore a product of natural selection.

The first three chapters provide a foundation for understanding the rest of the work. Stevens provides a helpful "Plan of This Book" that acts as a roadmap for the structure and a teaser of the chapters to come. Chapters two and three dispel popular misconceptions of what anthropology is, define the role of anthropology in evaluating extraordinary claims, make the claim that magic and witchcraft represent universal ways of thinking based on the similarities of the human experience across societies and the structure of the human brain, and explain how the supernatural fits under the broader category of religion.

Chapters four through six introduce the topic of the book proper—magic and witchcraft. Stevens makes it quite clear "*witchcraft* in this book is a system of beliefs in the operations of an imaginary anti-social and mostly evil being" (p. 1). This is important; by narrowing his focus to what we may understand as *maleficia*, that is, magical practices of a harmful, anti-social nature, Stevens maintains focus and doesn't get lost in



Rethinking the Anthropology of Magic and Witchcraft. By Phillips Stevens Jr. Routledge, 2024.

the witchy weeds. Types of ritual activity are discussed (e.g., blessings, curses, incantations) leading into an exploration of what he argues are the fourteen attributes of the "witch" (e.g., shape-shifting, infanticide, cannibalism). While the concept of a *witch* properly understood is a uniquely Christian one, the fearsome attributes of the witch represent fears and anxieties found in every human culture. After all, everyone wants to keep their children safe, everyone wants themselves and their loved ones to remain healthy, and everyone wants to live in relative peace and prosperity. Witches, regardless of the culture, are those upon whom blame is placed for disrupting the social order and deliberately bringing misfortune and death upon their neighbors by magical means.

Chapter eight analyzes those unique attributes of the witch too specific to be included under the previously discussed attributes, such as the common Western depiction of the witch flying astride a broom (sometimes naked). Some cultures, however, depict witches flying upside down or backward, and as Stevens points out, in parts of Africa and Oceania they may emit jets of fire from various bodily orifices. The manner in which witches obtain their magical powers also varies from culture to culture. Some believe that the witch's power is hereditary and that witches exist as generational covens in which initiation is a birthright and the knowledge is passed down. Others believe that one may seek out a witch to learn their craft or make a pact with evil spirits in exchange for knowledge and power, the veritable Faustian bargain.

In his conclusion, Stevens examines how the attributes of the witch continue to elicit fear and paranoia in modern times. He draws a line from the witchcraft hysteria of Early Modern Europe and New England to the Satanic Panic of the 1980s and 1990s and beyond to the QAnon and related movements of the new millennium. The persistence of such beliefs in agents posing a threat not just to the most vulnerable members of society (i.e., children) but to the very fabric of the social order, and that those agents work not in isolation but as part of a vast and far-reaching conspiracy, is evidence that "Witch beliefs are inherently human" (p. 164).

Rethinking the Anthropology of Magic and Witchcraft is a must-read for anyone interested in the study of witchcraft as a social phenomenon—witchcraft as a collection of beliefs that, while they may differ given a particular socio-historical context, nevertheless offer solutions to uniquely human problems. ■

Autumn Sword is an investigator and host of the podcast *The Devil in the Details*.

Mental Health and Wellness: Clarifying Fuzzy Boundaries

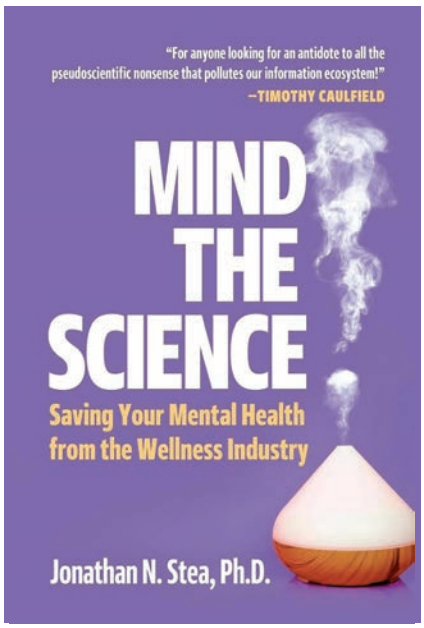
Cassandra L. Boness

In an era of rampant mental health misinformation, Jonathan Stea's *Mind the Science: Saving Your Mental Health from the Wellness Industry* is a critically important contribution to the literature on pseudoscience. Drawing on years of expertise as a clinical psychologist, Stea artfully achieves the aim of his book: to "educate and embolden" people to make informed decisions about their mental health by providing the tools needed to avoid harmful misinformation spread by the wellness industry.

In three parts, Stea provides the building blocks of what is needed to differentiate science from pseudoscience: a crash course in science and psychopathology, pseudoscience warning signs, and a primer on what mental health really means. Stea balances providing knowledge and skills to the reader with exemplifying each building block in relevant, real-life examples that keep the reader engaged while helping the reader effectively identify pseudoscience wellness grift.

One of the major contributions of this book is the direct focus on the harm that misinformation can cause to people and society at large. As a clinical psychologist myself, I have heard colleagues suggest that it shouldn't matter if a treatment is pseudoscientific as long as the client benefits. The dangerousness of this claim is directly addressed in Stea's book. He makes it clear that pseudoscience is not an innocent game; it can exploit people's money, reduce the likelihood that people receive effective treatment, wear down trust in science, and lead to extreme consequences—including death.

These harms are demonstrated through real-world examples, such as the story of Kirby Brown, who tragically lost her life alongside three others in 2009 during James Arthur Ray's "Spiritual Warrior" wellness treatment in Sedona, Arizona. But Stea doesn't stop by just identifying and elucidating harm. He offers real solutions by showing how to embody intellectual humility, how to identify common thinking errors, and how to ask the right questions when searching for quality mental health information online.


"For anyone looking for an antidote to all the pseudoscientific nonsense that pollutes our information ecosystem!"
—TIMOTHY CAULFIELD
MIND THE SCIENCE
Saving Your Mental Health from the Wellness Industry
Jonathan N. Stea, Ph.D.

Mind the Science: Saving Your Mental Health from the Wellness Industry. By Jonathan Stea. Oxford University Press, 2024.

A second major contribution is his awareness that pseudoscientific practices can be appealing to people who have valid reasons not to trust science or the health care system. This can understandably lead people to look outside of mainstream medicine for mental health care. But it can also create a greater vulnerability to harmful misinformation, especially in the case of pseudoscientific treatments that oversell and misrepresent the evidence.

Normalizing and validating the legitimate skepticism of people who have been harmed by science and health care is an important first step and can help us understand what might put people at risk of being harmed by the pseudoscientific wellness industry. A greater understanding of people's preferences for treatments is also helpful for directing future efforts on the evaluation of treatments that may be evidence-based but may have been overlooked by those who traditionally apply such criteria and promote evidence-based interventions.

Throughout the book, Stea touches on his experiences confronting and correcting misinformation on social media. Although some may view this as a futile effort, I believe it clearly demonstrates his dedication in this area. In my experience, challenging misinformation and pseudoscience online can come with real risks and have implications for one's professional life, yet Stea persists. Although social media advocacy might not be for all of us, Stea's book demonstrates that there are various ways for professionals and the community to challenge misinformation and promote evidence-based mental health care.

Drawing on the critical scholarship of other experts in pseudoscience, psychopathology, and evidence-based practice, this book is a demonstration that, despite their fuzzy boundary, science and pseudoscience can indeed be differentiated. ■

Cassandra L. Boness, PhD, is a licensed clinical psychologist and assistant professor in the Department of Psychology and at the Center on Alcohol, Substance use, And Addictions (CASAA), University of New Mexico.

For more, view Jonathan Stea's *Skeptical Inquirer Presents* video about this book by scanning the QR code above.

HOT TAKES

Joker, Beetlejuice, and the Talking Mongoose

Joker: Folie à Deux

I quickly realized that I'd be leaving the theater in anger when the opening scenes of *Joker: Folie à Deux* set the stage for pop psychology poppycock, especially as related to multiple personality disorder (the film takes place in 1983, prior to the updated diagnostic label of dissociative identity disorder). Older films (e.g., *Sybil*) and newer films (e.g., *Split*) commonly misrepresent this disorder, and in this film a lawyer floats the idea that the Joker is Arthur Fleck's alternate personality. And yet, I was wrong. Instead of making me angry, this film gave me joy. If you can handle the violence, you too might find joy in this "jukebox musical psychological thriller."

Stephen Hupp
Coeditor of *Pseudoscience in Therapy*

Beetlejuice Beetlejuice

This movie is a wonderfully quirky blast from the past. I started off worried that the sequel might introduce some awkward new element that would undermine the legacy of the first film (like Jar Jar Binks did for *Star Wars*). Fortunately, my fears were unfounded because this film captured all the charm and humor that made the original *Beetlejuice* a success. They even brought back an iconic song from the original in a somberly amusing way that didn't feel *too* forced into the storyline. Michael Keaton and Winona Ryder portrayed the characters of Beetlejuice and Lydia Deetz with the same enthusiasm and eccentricity they had in the original. Jenna Ortega, as Lydia's estranged daughter, Astrid, fits effortlessly into Tim Burton's wild and wacky world, complementing the returning cast exquisitely. In summary, *Beetlejuice Beetlejuice* is a fitting continuation of the story—a definite must-see!

Daniel A. Reed
Founder of the West Virginia Skeptics Society

Nandor Fodor and the Talking Mongoose

I was so excited to see a film adaptation of one of my favorite paranormal tales: "Gef the Talking Mongoose." Even more so when I learned Simon Pegg, Christopher Lloyd, and Minnie Driver were involved. Gef (pronounced "Jeff") was believed by 1930s Isle of Man residents to live in the Irving family farmhouse. Sightings were rare, yet many claimed they had heard him speak. Pegg plays parapsychologist Nandor Fodor, one of multiple investigators who traveled to the island. While the film sets up the requisite themes of belief, deception, and paranormal investigation—plus the absurd humor of a talking mongoose—it never pays off with a consistent tone or viewpoint. There are moments of humor and exaggerated pathos. The young Voirrey Irving is shown to be a ventriloquist, but we are also shown a computer-rendered mongoose. With better writing and direction, this could have been uproariously funny, an important lesson about critical thinking, or both. Instead, we're left with quality parts that never come together.

Ross Blocher
Longtime cohost of *Oh No, Ross and Carrie!*

Send in Your Hot Take!

Hot Takes are for recent movies or shows and should be no more than 225 words. Those selected may be edited for space, clarity, and/or spoiler prevention. Submit your Hot Take by email text to letters@skepticalinquirer.org. Include your full name and occupation. Do not include attachments.

SECRETS REVEALED

Skepticross Answer

1 S	2 A	3 V	4 E
2 E	X	E	D
3 T	I	R	E
4 I	S	B	N

Word Noodle Answer

SCIENCE

Hidden Message Search Answer

Nerds Should Guide the Humans. The message is the second half of a longer quote from Bill Nye: "Humans Control the Earth; Nerds Should Guide the Humans."

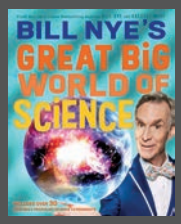
Peek Inside the *Way Cool Game of Science*

A Few Words on the Rail Fence Cipher

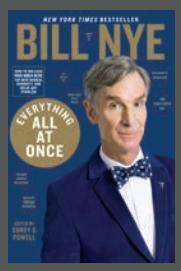
FDTEAESSYIEIICDIGMRPEETAOVGONERNT

[NYE AND NOTABLE BOOKS

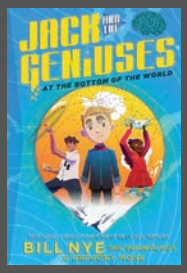
Edited by Stephen Hupp



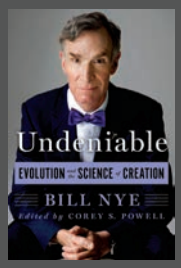
BILL NYE'S GREAT BIG WORLD OF SCIENCE. For children ages ten-years-old and up, "Nye and coauthor Gregory Mone present the most difficult theories and facts in an easy-to-comprehend, humorous way." The book also includes "experiments kids can do themselves to bring science to life!" Harry N. Abrams, 2020.



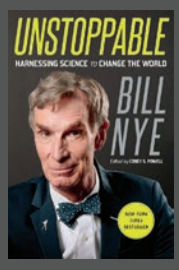
EVERYTHING ALL AT ONCE: How to Unleash Your Inner Nerd, Tap into Radical Curiosity and Solve Any Problem. If you read one book by Bill Nye, make it this one! Check out page 211 for his praise of the Committee for Skeptical Inquiry (CSI). Alternatively, enjoy listening to the audio version read by the author himself. Rodale Books, 2017.



JACK AND THE GENIUSES: At the Bottom of the World. This first book in a three-book series targets eight- to twelve-year-olds and offers an exciting premise: "A contest to find a better way to create clean drinking water turns into a mystery when one of the scientists goes missing." Amulet Paperbacks, 2018.



UNDENIABLE: Evolution and the Science of Creation. Do you remember Bill Nye's controversial debate about creation? If you don't know the story well, this book is the best place to learn more. In the book, Nye argues "The science of evolution is as expansive as nature itself. It is also the most meaningful creation story that humans have ever found." St. Martin's Press, 2014.



UNSTOPPABLE: Harnessing Science to Change the World. Related to Bill Nye's SKEPTICAL INQUIRER Special Section on Climate Change (this issue), in this book, Nye "debunks some of the most persistent myths and misunderstandings about global warming." St. Martin's Press, 2015.

Mystery House

Adrienne Hill's article "The Truth about Sallie Winchester and the Mystery House That Never Was" (SI, September/October 2024) effectively debunks every misconception of Sallie Winchester and her so-called "mystery house." I visited the Winchester Mansion as a young child and was fed the misinformation surrounding Winchester on the tour as irrevocable truth, fully believing that Winchester was yet another infamous tale of a woman's descent into madness. It is only now, over a decade later, that reading Hill's article has righted Winchester's story in my mind. For too long, Winchester has been written off as "crazed" and "superstitious." Hill approaches this topic with compassion, empathy, and, most importantly, fact. I applaud Hill for the article and for all the work she has put into reclaiming Winchester's story.

Alise Forsyth
Edwardsville, Illinois

Editor Stephen Hupp responds:

If you enjoyed this article, then you'd also enjoy a video by Coleman Watts, titled "The Winchester Mystery House: Ghost – BUSTED! (Debunking Destination Fear)" on the @ThinkThisThroughChannel on YouTube?

Swift Conspiracies

I am a huge fan of Taylor Swift; I have been since she released *Love Story* in 2008. In the September/October 2024 SI issue, it was refreshing to read an article about her that critiques the conspiracy theories rather than dissecting her love life or other drama. There are so many conspiracy theories out there that some theories even extend to her fanbase. Similar to the Pentagon Psy-Op theory mentioned in the article, many conspiracy theories suggest that Swifties are mind-controlled and will help her overthrow the government. In the *Miss Americana* documentary, Swift shows how she went against some advisors' recommendations when she urged people to vote. She even released a song with that documentary that helped push younger generations to make a change, and these actions reinforced the mind control conspiracy theories. Admittedly, Swift does play into some of these theories when she leaves easter eggs in her posts, videos, and music. In this way, she uses the conspiracy theories for her own gain in that it keeps her fans engaged.

Alex Harman
Lebanon, Illinois

Tarot Coincidence Reverse Polarity

The September/October 2024 issue of SI was stuffed with interesting articles. I particularly enjoyed "Is Belief in Improbable Theories Ever Warranted? A Fortune Teller's Own Death Card" by Lee McIntyre. McIntyre conducts a fascinating examination of the interplay between scientific attitude, prediction, probability, coincidence, correlation, evidence, and belief while telling the story of Tarot card reader Maga Mago. Mago supposedly pulled the "death card" from the Tarot deck five times in a row and, as a result, correctly predicted he would die within two weeks. McIntyre asks what it would take to get us to alter our beliefs. In cases such as the Tarot card reader, I always apply what I call Coincidental Reverse Polarity Confirmation. Simply reverse the terms of the coincidental occurrence. If Mago or anyone else could have died five times in a two-week period and then drawn a single death card from the Tarot deck, I'd be a believer.

Karl Felsen
Guilderland, New York

Tarot Coincidence: Psychosomatic Cause?

Regarding Lee McIntyre's article, his discussion of the probabilities works from the assumption that "there is no relationship between pulling the death card in a Tarot deck and dying soon after." However, with a strong correlation with high improbability without a known causal connection and without known fraud, etc., isn't it time to look for an unknown natural cause? In this case, a psychosomatic causal connection could explain the otherwise improbable occurrence. Aren't there examples where terrifying beliefs kill? He draws the Death Card and then dies via depression and fear.

Jonathan Widger

Lee McIntyre responds:

Interesting idea. Sort of like a reflexive prediction. But are there actually documented cases where someone frightened themselves to death?

EMDR's Neurobiological Conjecture

As a psychologist who has published in psychotherapy outcome, I agree with Gerald Rosen and Loren Pankratz's article, "Eye Movement Therapies, Purple Hats, and the Sagan Standard" (SI, September/October 2024). Eye movement desensitization and reprocessing (EMDR) therapy tends to be effective, but this is most likely because it is a form of exposure and desensitization therapy, which tend to be effective. Years ago, I was not impressed with vague and questionable explanations for the effectiveness of the eye movement component of EMDR, which claimed that the eye movement facilitates processing between the brain hemispheres and/or that the eye movement is somehow like the rapid eye movement (REM) that occurs during dreaming. A psychology professor of mine once said that a psychological theory that includes neurobiology tends to be afforded more credibility than a psychological theory that does not. With a credulous audience, a thinly supported neurobiological conjecture can be a hands-down winner.

Andrew D. Reisner, PsyD
Cambridge, Ohio

Scooby Doo Pseudoscience

I have a long-standing viewership of the Scooby gang. In fact, I'd say it is one of the sources of my long-standing interest in bogus science. On a couple of points in Benjamin Radford's excellent review (September/October 2024) of all the Scooby Doo media, I feel I must take issue with a few of his claims. Radford at one point states that the bad guy always turns out to be a guy in a rubber mask practicing some form of pseudoscience as an explanation for his evil deeds. He also says the action almost always takes place in a haunted landscape characterized by trees that are "twisted and bare." He goes on to say episodes nearly always involve "dead leaves blowing across the ground." While I recognize that this statement characterizes the majority of cases, especially in the early years of the Scooby gang's adventures, I take issue with such statements in recent episodes and films. For evidence, I offer *Scooby Doo and the Gourmet Ghost* and *Scooby Doo and WrestleMania Mystery*, among many other recent films. Scooby finds himself in opulent surroundings often in recent films. It might be even more scary to kids (and adults) to find the evil-doing going on in clean, modern, sometime even luxurious surroundings. Perhaps evil may strike at any moment in

the most unlikely spaces. Notice I say *might* be scarier for children, although I suspect even children realize this cartoon includes bogus science; I offer Wile E. Coyote who regularly falls off cliffs of great heights only to return again and again without serious injury (as do characters from the Scooby gang). But no one seriously believes that this breach of science is to be taken seriously. Even breaches of the most sacred principles in physics can be taken with a laugh. But there *are* instances of apparently real ghosts, goblins, and ghouls in recent films such *Scooby Doo on Zombie Island* and *Scooby Doo and the Return to Zombie Island*. In these films, we're led to believe that such entities are very real. Whether this is enough to lead children, or even adults, to believe in pseudoscience, awaits an answer. Personally, I doubt it, but who knows without research? Perhaps tender minds, or for that matter aged ones, are opened to belief in real goblins and ghosts? Maybe the "meddling kids" are a source of such beliefs. Only time will tell.

Raymond A. Eve, PhD
Asheville, North Carolina

Ben Radford responds:

I appreciate Prof. Eve enjoying my review of Mark Norman's book Zoinks! I agree with him that few (if any) cartoon fans—child or adult—likely believes that breaches in science (such as Wile E. Coyote falling off cliffs) are to be taken seriously. However, he is mistaken in attributing claims and phrases to me. Nowhere in my review did I state or suggest that "the bad guy always turns out to be a guy in a rubber mask practicing some form of pseudoscience as an explanation for his evil deeds," and it is author Norman—not me—who notes that (in the early series specifically) "trees were twisted and bare" with "dead leaves blowing across the ground."

Mandela Effect (Correction)

I enjoyed the article on the Mandela Effect (SI, September/October 2024), like almost every article in your fine publication. I have one suggestion, however. The article states that "under the Copenhagen interpretation of quantum physics, at each quantum event the universe splits into parallel versions that exist simultaneously." This is most emphatically *not* the Copenhagen interpretation but as near as possible to its opposite in terms of quantum interpretations. The interpretation referred to is sensibly referred to as the Many Worlds interpretation and was first introduced by Hugh Everett III in 1957, whereas the Copenhagen interpretation was worked out by Niels Bohr and colleagues over a handful of decades starting in the late 1920s. In brief, the Copenhagen interpretation says that a quantum mechanical event (such as the striking of a detector by a photon) causes the particle to take on a real existence, and it does so following the application of probabilistic rules to its randomized attributes. Because randomness is virtually impossible for humans to understand, Everett dispensed with it, saying that the seemingly randomized outcomes of quantum events (will the particle hit one detector or another?) all happen without any coin-flipping, giving rise to bifurcating universes instead of a randomly chosen trajectory through a single, unbroken one. The difference for a non-specialist is apparently a minor matter of terminology (though I'm thinking of submitting an article to SI on this subject), but perhaps no more so than Dolly's braces. Which brings to mind that the sentence quoted above might be another of the magazine's easter eggs, self-referentially presenting a case of the Mandela effect itself

John Jamison
Walla Walla, Washington

Editor Stephen Hupp responds:

Although the September/October issue did have quite a few easter eggs, this was not one of them. Thank you for sending in this clarification. We have corrected it on the digital version of the article.

Are Plants Conscious? The Debate Continues Online!

Editor's note: In his September/October 2024 column, Massimo Pigliucci makes the case that plants are not conscious. As an online exclusive, Arthur S. Reber, František Baluška, and William B. Miller Jr. disagreed with Pigliucci's conclusions (see "Comment on Massimo Pigliucci's 'Are Plants Conscious?'"). Pigliucci then replied to their comment (see "After All These Years, Still No Evidence of Consciousness in Plants: A Reply to Reber et al. on Plant Consciousness"). To read these digital articles, search for the author names at skepticalinquirer.org/s/.

Send in a Letter to the Editor

Letters to the Editor are for views on matters raised in previous issues. Letters should be no more than 225 words. Due to the volume of letters received, not all can be published. Those selected may be edited for space and clarity. Authors criticized in the Letters column may be given the opportunity to respond in the same issue. Submit Letters to the Editor by email text (not attachment) to letters@skepticalinquirer.org. In the subject line, provide your surname and informative identification, e.g., "Smith letter on Jones evolution article." Include your name and location (City, State) at the end of the letter.

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